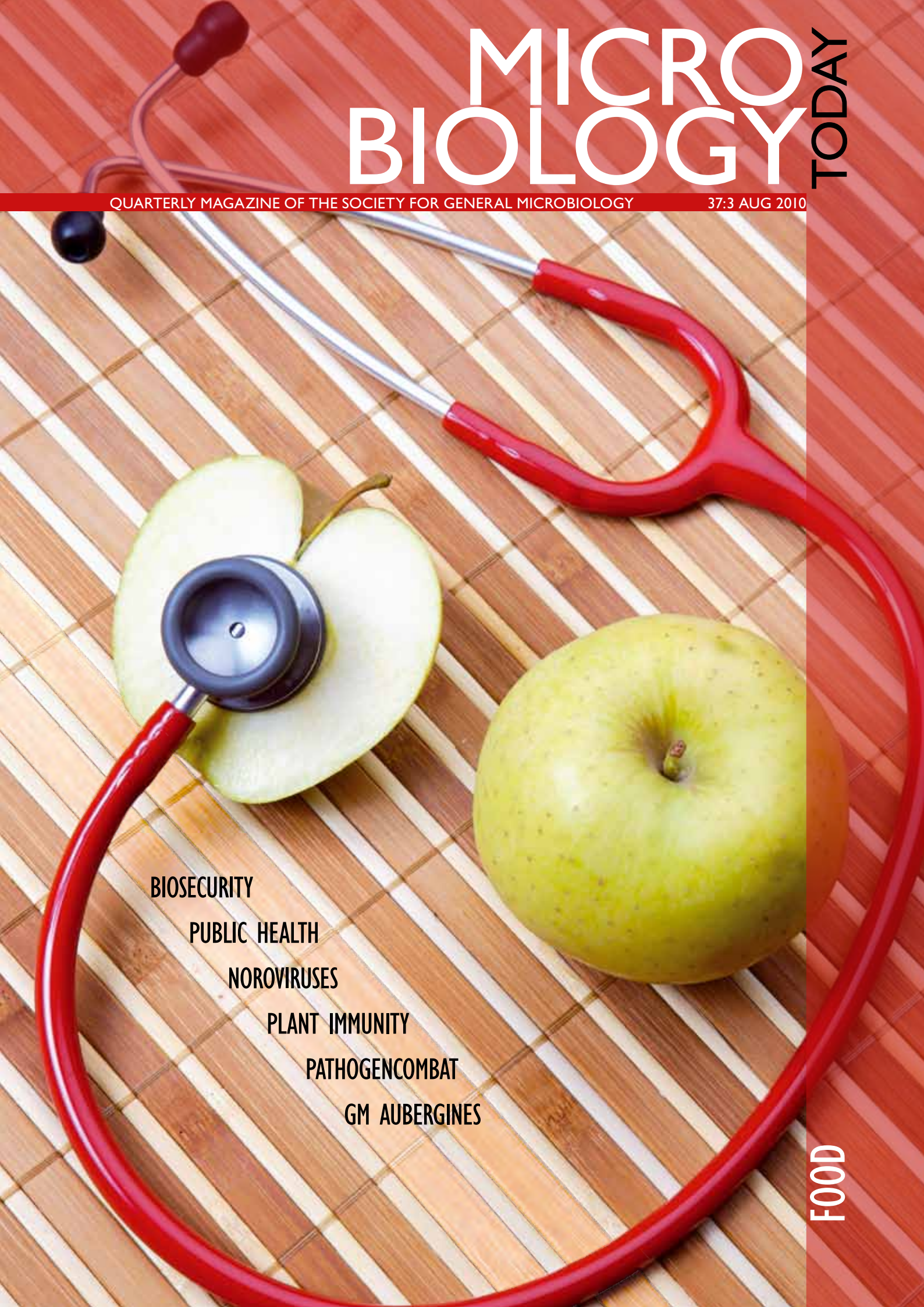
MICRO BIOLOGY TODAY

QUARTERLY MAGAZINE OF THE SOCIETY FOR GENERAL MICROBIOLOGY 37:3 AUG 2010



BIOSECURITY

PUBLIC HEALTH

NOROVIRUSES

PLANT IMMUNITY

PATHOGENCOMBAT

GM AUBERGINES

FOOD

COVER IMAGE
How healthy is our food?
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37:3 AUG 2010 CONTENTS

FEATURES

REGULARS

NEW MANAGING EDITOR OF *MT*

IAN ATHERTON joined SGM in 1990 after gaining a BSc (Hons) in Biochemistry at Manchester and 3 years working with Ed Southern in Oxford. Initially, he worked as a copy-editor on *JGM/Microbiology*, but he took an early opportunity to assist with production of the *SGM Quarterly*, eventually taking over as Production Editor. Ian has also been responsible for several design projects, including the redesign of the Society's journals in 2003 and two major redesigns of *Microbiology Today*. In 2004, he was appointed Design Manager, and produces many of the Society's conference, education, careers and advertising materials.

He says, '*Following Janet in the role of Managing Editor is daunting to say the least as she has done such a marvellous job in cultivating the magazine's reputation, but I am fortunate to be supported by a strong team. I look forward to working with Paul and all the Editorial Board, Meriel, and all the Marlborough House team, and with such back-up, I see no reason why the magazine shouldn't continue to go from strength to strength.*'

Ian's other interests include vegetable- and fruit-growing, bryology (he is a Member of Council of the British Bryological Society, Editor of their membership magazine, *Field Bryology* – talk about a busman's holiday – and was recently co-editor of a new field guide to British and Irish mosses and liverworts), and together with his wife Alex, he has recently taken up beekeeping!

Photo Alexandra Atherton

NEW MEMBERS OF COUNCIL

PROFESSOR NIGEL BROWN, Vice Principal and Head of the College of Science and Engineering, University of Edinburgh, and **PROFESSOR JOHN SINCLAIR**, Department of Medicine, University of Cambridge, have been elected unopposed to serve on Council for 4 years from 7 September 2010.

Profiles of the new members will appear in a future issue of *Microbiology Today*.

Address Book 2010

A new edition of the SGM Address Book, containing a list of the names and contact details of Society members and other useful information about SGM is being compiled and will be distributed with the November issue of *Microbiology Today*.

Please let the Membership Office have any changes to your address, telephone/fax numbers or email details as soon as possible, but not later than **16 August**. Send them to **members@sgm.ac.uk**

Also, if anyone wishes to have all or any of their details omitted from the Address Book and has not already notified the Society, they should do so immediately.

ANNUAL GENERAL MEETING 2010

The AGM of the Society will be held on Tuesday, 7 September 2010 at the Society Meeting at Nottingham University. Agenda papers, including reports from Officers and Division Chairs and the Accounts of the Society for 2009 are enclosed with this issue of Microbiology Today.

JMM IN THE NEWS

On 18 May, *BBC Online* picked up a press release issued by our External Relations Administrator **LAURA UDAKIS** about a paper published in the June 2010 issue of *Journal of Medical Microbiology* on the resistance of urinary tract infections to antibiotics. The paper, from a group in Hong Kong, presents evidence that resistance genes are being passed from animals to humans, a problem exacerbated by the overuse of antibiotics in the farming industry. The piece was one of the top stories on the BBC's health pages and the page contained a prominent link to the *JMM* website. The story can be found at **http://news.bbc.co.uk/1/hi/health/8687512.stm**

Two more fond farewells

Following the retirement of Josiane Dunn in April, we have said goodbye to two more long-serving members of the Marlborough House team.

JANET HURST

Photo Laura Udakis

There are probably few members of SGM who aren't aware of Janet and the great contribution she has made to the activities of the Society over the last 20 years. As one former member of Council put it recently, '*when one thinks of SGM, one thinks Janet!*' As well as contributing so much to the success of *MT*, as reported in the last issue, Janet has been responsible for the development of SGM's education and outreach activities and had overall responsibility for the membership and meetings offices for many years. She also proved herself to be a valuable colleague to Ron Fraser in her role as Deputy Chief Executive Officer.

Janet's final days at SGM were spent representing the Society, as she has done on countless occasions, at the American Society for Microbiology's annual meeting. Before she left for San Diego, we enjoyed an excellent farewell lunch at Marlborough House, prepared with contributions from many of the staff, at which Janet was presented with a card and gifts. Unfortunately, Ron was unable to attend, but Richard Noble read out a letter from Ron in which he expressed his personal gratitude for Janet's long service to the Society and his 14-year collaboration with her.

Janet will be succeeded by Dariel Burdass and Jane Westwell who have both been promoted to take charge of the Education and Public Affairs, and Meetings and Membership offices, respectively (see p. 142). Ian Atherton takes over as Managing Editor of *Microbiology Today* (see opposite).

Janet would like to thank everyone for their cards, good wishes and retirement gifts, and we all wish her well as she enjoys a richly deserved rest.

RICHARD NOBLE

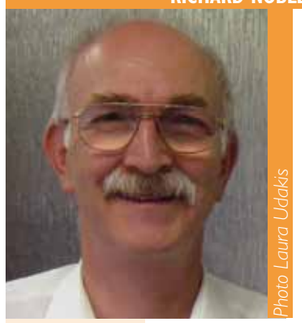


Photo Laura Udakis

Perhaps less in the public eye, but no less important in maintaining the Society's good health is our retiring Finance Manager. Richard's fastidiousness and experience of financial matters has meant that SGM's accounts have been managed by a very safe pair of hands; a great testament to this is the current financial health of the Society in difficult economic times. During his 13 years at SGM, Richard has overseen a number of major changes, not least the transition from print-only to online journal subscriptions, and more recently the change to tiered pricing. His astute judgement and considered counsel enabled both these major changes in the Society's financial model to take place seamlessly.

Richard's replacement, Suzanne Beaumont (see p. 75 of the May issue), took over the accounting reigns in March this year, and for the last few months Richard has devoted his time to developing a new marketing campaign for the SGM journals.

Richard's unique but much-loved sense of humour will be missed around the building. His 'jokes' will haunt us all for some time, but we will remember Richard with great affection. He leaves us with our very best wishes, and will no doubt be happy to swap the time spent pouring over the ledger book for time studying his bumble bees and butterflies, and nurturing his bamboo collection.

NEW SCIENCE MINISTER

In the UK at least, it could hardly have escaped anyone's attention, that we have a new Government following the General Election on 8 May. One of the most important appointments within the Government from an SGM perspective is undoubtedly that of Minister of State for Universities and Science. Conservative MP **DAVID WILLETTS** has been appointed to this position. Although this is not an official Cabinet post, he will attend all Cabinet meetings.

David studied Philosophy, Politics and Economics at Christ Church, Oxford. In the Shadow Cabinet he has held a number of posts, ranging from Shadow Education Secretary to Shadow Secretary of State for Trade and Industry, and most recently he was Shadow Secretary of State for Innovation, Universities and Skills. Because of his reputation as an intellectual and his ties to academia, he has been nicknamed '*Two-brains*' by the media.

We wait with interest to see how David and the new coalition Government manage science and university funding in these difficult times.

MAY COUNCIL MEETING HIGHLIGHTS

MARLBOROUGH HOUSE BUSINESS

Council bid goodbye to two stalwarts of Marlborough House. **RICHARD NOBLE**, the Society's finance director, will retire in June 2010. His successor, **SUZANNE BEAUMONT**, has already started in post to 'learn the ropes' from Richard. **JANET HURST**, Deputy Chief Executive Officer, completed her 74th and final Council meeting before taking retirement. Her role servicing Council will be taken by the internal promotion of **JANE WESTWELL**. Council wished both Janet and Richard long and happy retirements. Likewise, **JOSIANE DUNN** retired at the end of April 2010 and **SUZANNE LEONARD** is settling in well to Josiane's position.

At Marlborough House, proceedings have begun to implement a new meetings and membership database system. It will cross-link with the finance database and enable a new, more interactive SGM website to be built. Because of the increased hardware capability required for these projects, tenders are being sought for a new server.

Two members of editorial staff are being recruited: one permanent, and one temporary to provide maternity cover for **NATALIE WILDER**, who is expecting her second child later this year. We send all good wishes to Natalie for the birth of her baby and look forward to her return in 2011.

In addition to the retirement of Josiane, Janet and Richard, SGM's Chief Executive Officer, **RON FRASER** will retire in July 2011. Council approved plans to begin this very important task of finding a replacement to Ron, which will begin in the summer. An appointments committee will be formed to oversee the process.

JANE WESTWELL gave a presentation to Council on SGM membership, including a review of numbers by category and an analysis of the trends in membership patterns over recent years. She also discussed the different grant schemes run by SGM to further international microbiology activities. Issues such as development and expansion of both areas, membership and international matters, will be considered by a working party chaired by **DR GARY ROWLEY**.

PRESIDENT'S BUSINESS

PROFESSOR HILARY LAPPIN-SCOTT commented on the value of the new Council meeting format in which specific subject areas are selected for discussion, such as Jane Westwell's presentation on membership and international matters. At the next meeting, Council will be presented with a review of the SGM conferences, including all aspects of costs, organized under the new matrix scheme. Professor Lappin-Scott's introduction to the *Annual Report* for 2009 was presented to Council.

GENERAL SECRETARY'S REPORT

Council was advised that nominations for the SGM Prize Medal lecture should be made in time for July's meeting, when the recipient will be decided. The Prize Medal is the pre-eminent SGM prize, awarded annually to a microbiologist of international standing whose work has had a far-reaching impact beyond microbiology. The recipient of this prize is nominated after consideration of nominees put forward by Council.

Other prize lectures for 2011 include the Fleming Prize, the Peter Wildy Prize, the Colworth Prize and the Fred Griffith Prize. The Fleming Prize is awarded annually to recognize outstanding research in any branch of microbiology by a microbiologist in the early stages of his/her career. The Peter Wildy Prize for Microbiology Education is awarded annually for an outstanding contribution to microbiology education, without restriction on the area of microbiology in which the award is made. This may include university teaching or education of the general public, school pupils or professional groups. The Colworth Prize is awarded biennially for an outstanding contribution in an area of applied microbiology and the Fred Griffith Prize is also awarded biennially in recognition of long and distinguished service in any area of microbiology. The call for nominations for these prizes appeared in the May issue of *Microbiology Today*. The closing date for nominations to be received at Marlborough House is **30 September 2010**.

The General Secretary presented his draft annual report for 2009.

TREASURER'S REPORT

Despite the continued uncertainty in the financial markets, the Society remains in a very healthy financial position, with around £10 million in investments. The Treasurer presented his draft annual report for 2009.

SCIENTIFIC MEETINGS OFFICER'S REPORT

The deputy Meetings Officer, **DR EVELYN DOYLE**, stood in for **PROFESSOR CHRISTOPHER HEWITT** who was stranded in Boston Massachusetts by the Icelandic volcano. Delegates' feedback from the online survey of the spring meeting in Edinburgh was very positive, other than the weather! The programme for the autumn 2010 meeting, to be held in Nottingham (6–9 September) is almost complete and that for the 2011 spring meeting, to take place in Harrogate (11–14 April) is well underway. A review of the newly introduced matrix format around which the conferences are now organized is underway and will be presented to Council at the July meeting.

EDUCATION AND PUBLIC AFFAIRS OFFICER'S REPORT

PROFESSOR JO VERRAN presented her draft annual report for 2009 to Council. SGM ran a hands-on activity for school children at the *Big Bang* science event in Manchester in March. Over 18,000 children participated in this, the largest schools science event in the country. At the SGM stand, around 2,500 children participated in a fun activity to reveal the importance of effective hand washing to prevent the spread of infectious organisms.

PUBLICATIONS OFFICER'S REPORT

PROFESSOR HOWARD JENKINSON presented his own report and those of the Editors-in-Chief of the four SGM journals. The establishment of a working party, chaired by Professor Jenkinson, was agreed to consider how to raise the profile of the SGM journals. It will report to Council at the November meeting.

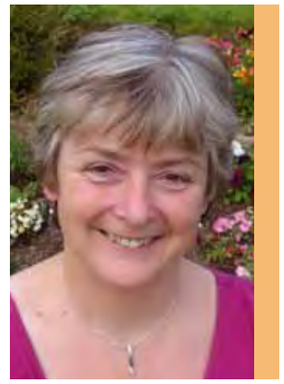
DR PAUL HOSKISSON, Editor of *Microbiology Today* revealed plans for future issues and noted that the new design had received positive comments. He also thanked Janet Hurst for the help she had given him in his new role as Editor.

The meeting concluded with a vote of thanks and best wishes from the President to Janet Hurst for a long and happy retirement.

DAVID BLACKBOURN, GENERAL SECRETARY

Peter Wildy Prize Lecturer Sue Assinder

Sue Assinder began her scientific career with a degree in Biological Sciences from Lancaster University, which was where she made her first contact with fungal genetics and laid the foundations for her future research interests in eukaryotic cell division. After postdoctoral work in Canada, she joined Bangor University in 1986 and remained there until 2008 when she moved to the Liverpool School of Tropical Medicine as its first Director of Education. She now runs a complex teaching effort that delivers postgraduate programmes not only in Liverpool but also in many countries around the world, particularly Africa and the Middle-East.



Throughout her career, Sue has worked extensively at promoting public engagement with science. As a result of winning the inaugural BBSRC Science Communicator Award in 1995, she wrote a school resource pack *DNA: The Recipe for Life*. This was produced in both English and Welsh, and subsequently translated into Chinese for use in workshops in Hong Kong and China. She followed this up with a second book – *How the Mushroom Got its Spots* – aimed at explaining the wonder of fungi. Over the years she has given numerous public lectures at diverse venues, from draughty village halls to the House of Lords, and spent countless hours engaging children and families with hands-on activities at science festivals and other public events.

Sue has just completed extended terms as SGM Education Officer and as Chair of the Education Committee of the Biosciences Federation. However, she has managed to fill the empty hours by taking over as Chair of the SGM Education Division and by embarking on new education roles with the Society of Biology and the British Mycological Society.

Sue enjoys walking, cycling and family life with her husband and three grown-up children, all of whom bring her much pleasure and have even proved to have their uses on occasion as guinea pigs for her educational activities.

Sue will present her lecture entitled **How the mushroom got its spots and other stories** *at the SGM meeting in Nottingham in September (see pp. 148–149 for details).*

PEOPLE

Staff

DARIEL BURDASS

As mentioned on p. 139, Dariel has been promoted to Head of Education and Public Affairs. Having been employed at the SGM as Education Manager for the last 10 years, Dariel was thrilled to be offered this opportunity to head up the Education, Professional Affairs and Outreach department. Building on the solid foundation that has already been laid, she looks forward to raising the Society's profile to politicians, journalists and the general public.


Dariel Burdass. *Alexandra Burdass*

Dariel says '*I have an excellent team working with me and we look forward to the challenges and success that I am sure lie ahead*'.

Outside of work Dariel is a keen though novice gardener, and also lapsed rower for Wallingford Rowing Club. She looks forward to getting back into training when September comes!


David Bradley. *Laura Udakis*

JANE WESTWELL

Jane is delighted to have been appointed Head of Meetings and Membership Services. After working as a postdoc at the University of Reading, she joined the SGM staff in 1997 and will be familiar to many SGM members from her years of managing grants and careers activities. She also worked closely with Janet Hurst and SGM Council on promoting and developing membership and, among other things, has overseen the increase in numbers of SGM grants the varied range of schemes that the Society offers today. In addition to her formal duties, Jane has always enjoyed working at SGM meetings and getting involved with outreach and education activities whenever an extra pair of hands has been required. Jane is very much looking forward to working with the existing meetings and membership office staff and will be welcoming a new grants and membership services administrator to the team later in the summer.


Jane Westwell. *Laura Udakis*

WELCOME TO...

With so many departures recently, it's refreshing to report the appointment of three new members of staff at Marlborough House, and we extend a warm welcome to them all.

Two 'Davids' have been employed as Staff Editors on the Society's journals.

DAVID BRADLEY joins us from the VLA, Weybridge, where he studied mycoplasma-related disease in animals. He holds a BSc (Hons) in Biology from the University of Bath and a BTech National Diploma in Foundation Art. He has also worked as a freelance illustrator and has undertaken a village education project in Tanzania. David will work mainly on *IJSEM*.

DAVID EYRE started his 1-year contract on *JGV* at the beginning of June to cover for Natalie Wilder's maternity leave. David studied Natural Sciences at the University of Cambridge, qualifying with a BA (Hons), and completed a DPhil at the Institute of Molecular Medicine, Oxford, where he worked on yeast telomeres. Following an International Visiting Fellowship at NIH, Maryland, USA, he returned to London, taking up a position as a Patents Technical Assistant.

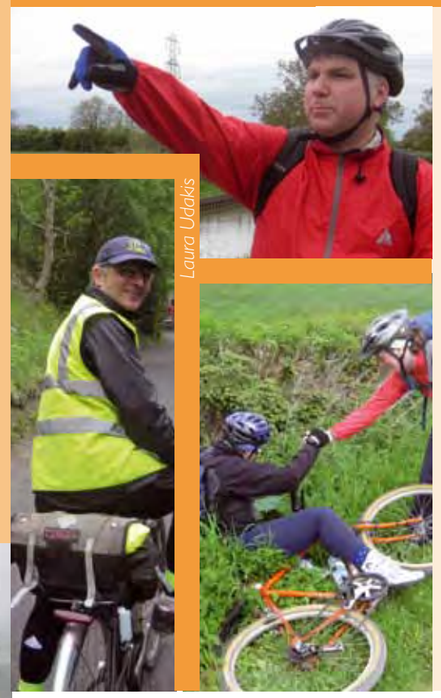
To assist Dariel Burdass in the Education and Public Affairs office, **VICKI SYMINGTON** has been appointed. After qualifying with a BSc (Hons) in Biosciences at Robert Gordon University and having obtained a PhD in fungal genetics in 2008 from St Andrews, Vicki has been involved with a range of science communication and education activities, including National Science and Engineering Week activities and as Project Co-ordinator for *Science: News and Views* (AstraZeneca), where she developed curriculum-linked school teaching resources.


David Eyre. *D. Eyre*


Vicki Symington. *Laura Udakis*

Laura, Dariel, Rachel, Stefan and Robin at the finishing line. *Karen Rowlett*

Lock up your bikes!


Laura Udakis

Cycling 100 miles might not be some people's idea of a fun weekend, but that's exactly what **ROBIN DUNFORD**, **STEFAN SIDOROWICZ**, **RACHEL WALKER**, **DARIEL BURDASS** and **LAURA UDAKIS** did one weekend in May, all in the name of charity.

The fund-raising activity was in aid of the Duchess of Kent House charity that runs the palliative care hospice in Reading. The staff there took care of our colleague Duncan McGarva who sadly passed away in April this year.

The intrepid five from SGM successfully completed the trip along the Kennet and Avon Canal from Bristol to Reading over 8–9 May and have just about recovered physically, if not mentally. Team SGM battled through wind, rain and rough terrain, repaired two dodgy saddles, helped one another off the ground a few times and managed to keep everyone motivated enough not to jump on the next train home – in between consuming huge quantities of chips and chocolate.

The trip was slightly more arduous than any of the team had anticipated, but a great experience. Most importantly, over £700 has been raised for the Duchess of Kent House charity, which made all the aches and bruises worth it!

LAURA UDAKIS, PRESS AND PUBLIC AFFAIRS MANAGER

MEMBERS

QUEEN'S BIRTHDAY HONOURS

DR SANDY B. PRIMROSE, High Wycombe, Buckinghamshire, is to receive Membership of the Order of the British Empire (MBE) for services to the Food Standards Agency and to science.

DEATHS

The Society notes with regret the death of **DR R.J.W. BYRDE**, formerly of Long Ashton Research Station, University of Bristol (member since 1957).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TRANSFERABLE RESISTANCE

A MUSICAL TRIBUTE TO THE ROYAL SOCIETY

Julian Anderson, son of former SGM Honorary Member E.S. Anderson, has composed a fanfare-like work for four brass groups commissioned by the Royal Society as part of their 350th anniversary celebrations. It will be played by the brass of the London Philharmonic Orchestra at their convocation in the Royal Festival Hall on the afternoon of 30 June 2010. Julian has called the piece *Transferable Resistance* in homage to his father's work on transferable drug resistance. It is dedicated to the memory of three Fellows/Honorary Members of the Royal Society, Professor Max Delbrück, Professor Bill Hayes (also a former Honorary Member of the SGM) and Julian's father, of whom the other two were good friends. E.S. Anderson was the 1975 SGM Marjory Stephenson Memorial Lecturer. The SGM Hayes–Burnett award is named after Bill Hayes who delivered the first SGM Fred Griffith Review Lecture in 1966.

VLA Scientific

The Veterinary Laboratory Agency has launched its new commercial brand – VLA Scientific – bringing together the Agency's broad range of commercial products and services under a new identity, and many benefits to VLA customers and partners. These include clearer information on VLA products and services as well as better access to the range of expertise at the Agency. Income from VLA Scientific will be reinvested to provide additional funding to support the continuing research, development and surveillance activities of the VLA.

The products and services to be offered by VLA Scientific include specialist laboratory reagents and diagnostic kits, testing services for veterinary practitioners and the pharmaceutical industry, veterinary research and development projects, vaccine development and testing and livestock health improvement scheme. For further information, see the new VLA Scientific website at **www.vlascientific.com**

Comstock / Thinkstock

Worldwide food alert system

A team of scientists from Kingston University, London, have developed a worldwide food alert system which could lead to more rapid naming and shaming of countries producing food containing harmful bacteria and toxins. The team, led by Professor Declan Naughton, chairman of a panel of independent experts appointed to assess the quality of the European Food Security Authority's scientific activities, claims that the easy-to-use computer tool can be used to monitor contaminated products, helping to prevent them reaching shop shelves and ensuring that food is safe to eat.

Currently, there is no single international system for monitoring food safety, despite the fact that there are thousands of alerts about contaminated food every year. This prompted the team to develop a program to analyse alerts and produce a global picture of the countries that trade and detect contaminated food that may cause health problems, or even be deadly.

Brand X Pictures / Thinkstock

Toxins in nuts, food recalled by major supermarket chains and imported products stopped by border agencies were among the alerts included in the analysis.

The program could also be applied to other global health hazards such as pest control or illegal animal or plant imports.

ATTITUDES TO FOOD TECHNOLOGIES

The results of a study of the attitudes of British people to food technologies has been published by the Food Standards Agency (FSA). The data were taken from the responses to FSA-funded questions included in the 2008 British Social Attitudes survey. People's knowledge of and attitudes toward various technologies, including genetically modified (GM) food, high-pressure treatment, gas-filled packaging and hypothetical foods with health benefits, varied considerably.

Interestingly, in addition to individuals with an innate high level of concern about food safety, a number of other characteristics were found in common in people who tend to be more concerned about food technologies, including being older, female and having a low income.

Familiarity with terminology is another important factor in the level of people's concerns. For example, 31% of people said they were concerned about eating food cooked in a microwave; 57% were concerned about eating food prepared in a magnetron (an alternative name for a microwave!).

The number of people with a strong attitude against GM food appears to have reduced since a similar survey was carried out in 1999. In the current study, 19% of those questioned supported GM food, compared to only 10% in 1999.

Celebrating the end of rinderpest

To celebrate the eradication of rinderpest virus, the Institute of Animal Health is organizing a symposium entitled *The Global Eradication of Rinderpest: Lessons for Future Challenges* to be held on 15 October 2010 at the Royal Society, London.

An essential tool in the fight against this disease was the vaccine developed by the late Walter Plowright whose obituary was published in the May issue of *Microbiology Today*. Speakers at the symposium will include many of those who made significant contributions to this outstanding achievement.

See **www.iah.bbsrc.ac.uk/press_release/2010/2010_04.htm** for further details.

iStockphoto / Thinkstock

GRANTS

SGM has a wide range of grant schemes to support microbiology. See www.sgm.ac.uk for details.

Any enquiries should be made to the:

Grants Office
SGM
Marlborough House
Basingstoke Road
Spencers Wood
Reading RG7 1AG
tel. 0118 988 1821
fax 0118 988 5656
email grants@sgm.ac.uk

Check out the current schemes, to ensure that you don't miss any deadlines.

UPCOMING DEADLINES

24 SEPTEMBER 2010 is the deadline for receipt of applications to:

- International Development Fund,
- Watanabe Book Fund,
- Elective and Trainee Support grants
- President's Fund for Research Visits

Postgraduate Student Meeting Grants

Applications for a grant to attend SGM's Nottingham meeting (6–9 September) must be received by **3 SEPTEMBER 2010.**

Other schemes in brief

Scientific Meetings Travel Grants

The scheme supports early career microbiologists wishing to present work at a scientific meeting, either in the UK or abroad. See rules on the website for eligibility criteria.

Seminar Speakers Fund

The Fund supports talks on microbiological topics in departmental seminar programmes. Applications are dealt with on a first come, first served basis during the calendar year.

Education Development Fund/ Public Engagement Awards

Grants are available to members for projects intended to lead to an improvement in the teaching of any aspect of microbiology relevant to education in the UK. Funding is also available for small projects to promote the public engagement with microbiology, such as workshops, talks, demonstrations, leaflets, and activities at science festivals. Applications are considered on a first come, first served basis during the calendar year.

Microbiology in Schools Fund

Teachers working in SGM member schools are invited to apply for grants of up to £1,000 to support microbiology teaching initiatives and events. All topics in microbiology will be considered but projects linked to climate change, health and food are particularly encouraged. Applications are considered throughout the year but should be made no less than 3 months before the planned activity.

Retired Member Grants

Retired members may apply for a grant to attend one SGM meeting each year. The award covers en-suite accommodation and the Society dinner. Applications for grants to attend the SGM meeting at University of Nottingham are now invited. Closing date: **3 SEPTEMBER 2010**.

Technician Meetings Taster Grants

These grants support attendance by eligible technicians at one SGM meeting each year. Applications for grants to attend the SGM meeting at University of Nottingham are now invited. Closing date: **3 SEPTEMBER 2010**.

Honeybees – *Apis mellifera.*

Tapping diverse wheat lines for antifungal genes

Antifungal genes in Asian wheat could broaden genetic resistance in US varieties to allow them to fight a devastating fungal disease. *Fusarium* head blight (FHB) is caused by *Fusarium graminearum* that infects the wheat heads, causing a decline in grain yield and quality. Although there is some existing resistance to FHB in US wheat, thought to be derived from Chinese varieties, there is concern that this will not be enough to fight *F. graminearum*. Scientists from the Agricultural Research Service (ARS) and the University of Kansas have sought new sources of FHB resistance from China, Korea and Japan. Of the 87 wheat lines tested, 26 showed high levels of FHB resistance. Some lines possessed genes for different forms of FHB resistance, known as types I, II and III. The scientists hope that these genes could be exploited to prevent a repeat of the FHB epidemic that swept through the Great Plains between 1998 and 2000 and cost America's wheat industry $2.7 billion in losses.

www.ars.usda.gov/is/pr/2010/100401.htm

Healthy wheat (left) and wheat showing symptoms of *Fusarium* head blight (right). *Keith Weller / ARS*

LAURA UDAKIS HIGHLIGHTS SOME RECENT MICROBIOLOGY STORIES

Co-infection linked to bee decline

A microbial team made up of a fungus and a family of viruses may be responsible for wiping out entire colonies of honeybees, researchers have found. Colony Collapse Disorder (CCD) has contributed to average losses of 30–35% of hives in the US every year since 2006. Scientists from the US Department of Agriculture found that when colonies were infected with the fungus *Nosema cerenae* at the same time as being infected with a specific type of RNA virus, the colony was more likely to collapse. The researchers think that while the fungus is transferred by the insects' excretions, the viral infection is spread by both contact among the bees and a parasitic mite that lives on them (*Varroa* sp.). The group believes that beekeepers should focus on the nutrition of their colony in the autumn which may help combat the fungal infection. As for the viruses, selecting bees with natural genetic resistance to RNA viruses could be the solution to prevent infection that leads to CCD.

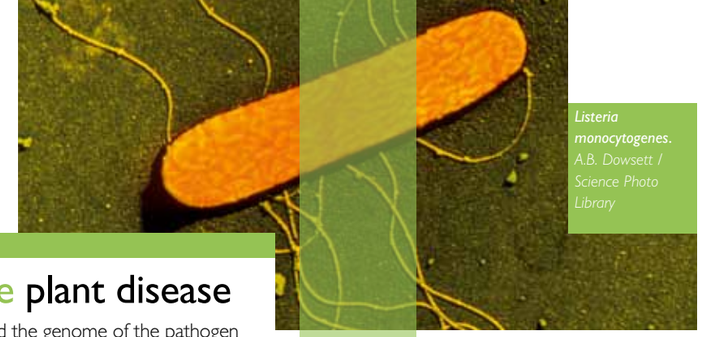
www.sciencedaily.com/releases/2010/05/100525154002.htm

Breast milk probiotic for IBS

Lactobacillus reuteri, found naturally in the guts of many mammals and also in human breast milk, reduces muscle contractions in the gut within minutes of exposure, according to a new study.

The Canadian scientists isolated pieces of small intestine from healthy, untreated mice through which a warm salt solution containing *L. reuteri* was passed. The pressure caused by natural contractions was measured before, during and after adding the bacterium. The decreased pressure following the addition of *L. reuteri* suggests that an increased uptake of this bacterium could potentially be used to help reduce symptoms for a range of gut disorders such as irritable bowel syndrome and inflammatory bowel disease.

***FASEB J* doi:10.1096/FJ.09-153841**



Listeria monocytogenes. *A.B. Dowsett / Science Photo Library*

Hope for TB-like plant disease

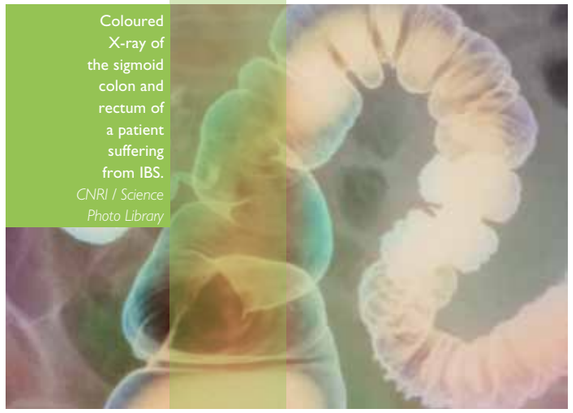
Scientists in Spain have sequenced the genome of the pathogen that causes a tuberculosis-type disease in olive trees. The bacterium, *Pseudomonas savastanoi* causes tumours that can grow to several centimetres in diameter on trunks, branches, stalks and buds. Affected trees have reduced growth and can be less productive, reducing their commercial value. To date there are no effective control strategies. It is hoped that the genome sequence of *P. savastanoi* will open the doors to identification of virulence genes which could help lead to specific strategies in the fight against the disease.

***Environ Microbiol* doi:10.1111/J.1462-2920.2010.02207.X**

Brainy bacteria?

Eating dirt may not be so bad for you after all and could even make you brainier, according to a new study that found certain types of soil bacteria could promote learning. *Mycobacterium vaccae* is a natural soil bacterium that people are likely to come into contact with outdoors. Earlier studies showed that *M. vaccae* had the ability to stimulate neuron growth in the brains of mice, which resulted in higher levels of serotonin and decreased anxiety. Knowing that serotonin plays a role in learning, scientists from The Sage Colleges in Troy, New York, assessed the ability of mice to navigate a maze. The mice that were fed live bacteria were able to navigate the maze twice as fast and showed fewer signs of anxiety compared to control mice. Further testing after the mice had returned to normal diets showed that the mice that had previously ingested bacteria were still faster than controls, but that this effect wore off after 3 weeks, showing that the enhanced learning effect was temporary.

www.sciencedaily.com/releases/2010/05/100524143416.htm



Coloured X-ray of the sigmoid colon and rectum of a patient suffering from IBS. *CNRI / Science Photo Library*

Break and enter

The human intestinal wall provides a tough barrier against potentially harmful bacteria in the gut. Now scientists have uncovered another piece of the puzzle of how *Listeria monocytogenes* can gain unauthorized access to cells and cause disease, and sometimes death. *Listeria* lives in soft cheeses and many ready-to-eat products, and although responsible for only 0.02 % of food-borne illness, causes more than one in four deaths linked to food-borne infection in the US. Researchers at Stanford have shown precisely how the tips of intestinal villi are most vulnerable to *Listeria* infection. The cells at these tips are constantly dying and being shed, at which point the surrounding cells quickly move together and re-assemble the tight junctions that prevent infiltration by microbes. *Listeria* exploits this process by manufacturing a couple of 'hooks' that target the cell adhesion molecules on the intestinal cells that are transiently exposed during tight junction re-assembly. One of the hooks allows the bacterium to latch on to the cell (internalin A) and the other activates the host cell's uptake system, allowing the bacterium to be internalized (internalin B). The researchers found that *Listeria* that lacked internalin B were much slower at entering the cells.

***PLoS Pathogens* doi:10.1371/journal.ppat.1000900**

MICROSHORTS

DELIVERING MODERN MICROBIAL SCIENCE

WWW.SGM.AC.UK/MEETINGS

Mo–Fe nitrogenase protein. *Laguna Design/SPL*
Geobacter metallireducens digesting uranium waste. *Eye of Science/SPL*

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Suggestions for topics for future symposia are always welcome.

Abstracts

Titles and abstracts for all presentations must be submitted through the SGM website by the advertised deadlines.

society for general microbiology
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AUTUMN 2010

University of Nottingham Jubilee Campus

6–9 September 2010

www.sgmnottingham2010.org.uk

METALS AND MICROBES

Microbes have evolved elaborate mechanisms to scavenge for the metals essential for many metabolic functions. Top international speakers will focus on the diversity of microbial metal homeostatic systems and also consider the importance of metals in microbial adaptation and in pathogenicity.

Complementary sessions will cover:
Bioremediation of metals
Bioleaching of metals – new technologies

OTHER SESSIONS

Systems & Cells
Microbial death | Acid stress: surviving and responding | Bacterial vesicles | New insights into secondary metabolism | Protein folding and misfolding

Medical & Clinical Microbiology
Respiratory and septic infections | Microbial models of human disease | Streptococci

Environment
Extremophiles | Microbiology in the indoor environment

Industry
Industrial Biotechnology 2025

Learning & Teaching
Learning from the evidence: improving microbiology teaching through educational research

WORKSHOPS

Prokaryotic taxonomy
Personal development for early-career microbiologists

SPECIAL LECTURES

Peter Wildy Prize Lecture: *Dr Sue Assinder*
Hot Topic Lecture
Outreach Prize Lecture

ALSO FEATURING

Sir Howard Dalton *Young Microbiologist of the Year* Finals
Poster sessions with drinks
Conference Dinner
Trade Exhibition

REGISTRATION

Registration couldn't be easier: simply register directly online at **www.sgmnottingham2010.org.uk** or complete (and return) the downloadable PDF.

Registration fees include; refreshments, lunch, drinks receptions, the abstracts CD, exhibition entry and all conference literature.

Specially discounted rates are available for:

- SGM Associate/Postgraduate Student Associate Members

Earlybird registration rate deadline: 6 August 2010

GRANTS

Conference grants are available to SGM Associate Members who are Postgraduate Students or Technicians.

CPD

Approved by the Royal College of Pathologists and the Institute of Biomedical Science. Up to 27 points available.

ACCOMMODATION

Dinner, bed and breakfast is available in en-suite accommodation on site. Please indicate your requirements clearly when registering.

FUTURE

Spring 2011
Harrogate International Centre
11–14 April 2011
Intracellular Life
www.sgmharrogate2011.org.uk

IRISH DIVISION

Autumn 2010
National University of Ireland Maynooth
2–3 September 2010
Insect-mediated microbial diseases of humans and animals: current problems and future threats
Organizer: Kevin Kavanagh (email kevin.kavanagh@nuim.ie; www.sgm.ac.uk/meetings/MTGPAGES/IrdSept10.cfm

Spring 2011
Queen's University Belfast
19–20 April 2011
Microbial viruses: genomics, evolution and applications in ecology, biotechnology and medicine
Organizer: Dr Leonid Kulakov

Autumn 2011
University College Cork
Marine biotechnology

For details of all Irish Division activities, contact John McGrath (j.mcgrath@qub.ac.uk)

OTHER EVENTS

SGM is supporting the following meetings:

Directing Biosynthesis 2010: Discovery, Evolution, Function
15–17 September 2010
Durham University, United Kingdom
www.rsc.org

Federation of Infection Societies
17–19 November 2010
Edinburgh International Conference Centre
www.fis2010.co.uk

European Society of Clinical Virology
13–15 January 2011
Institute for Child Health, London
www.escv.org/meetings/meetings.asp

MONICA WINSTANLEY
CELIA CAULCOTT

iStockphoto / Thinkstock

As the human population continues to grow, ever greater demands are placed on food production. What contribution can microbiologists make to ensure that the supply of food to all people is secure in this uncertain and changing world?

Stockbyte / Thinkstock

Food security, microbiology and research

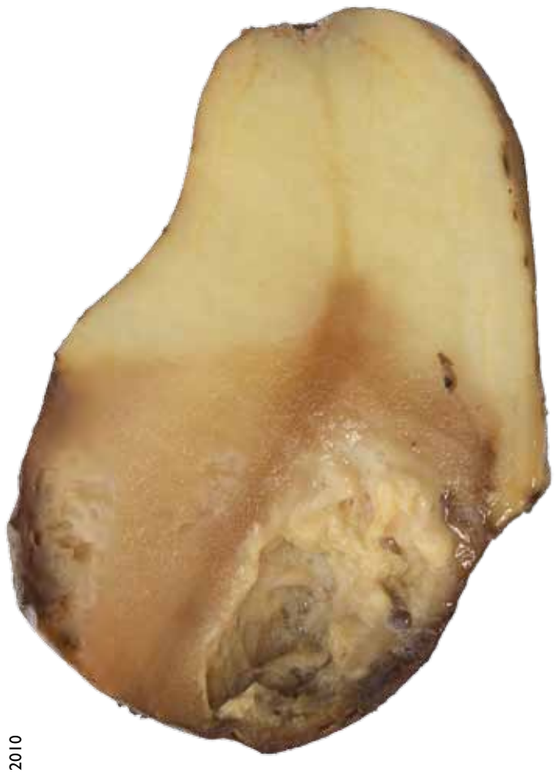
AROUND 800 MILLION people lack food security, which means they do not have adequate access to safe and nutritious food. The global population is expected to exceed 9 billion by 2050, and demand for food is likely to increase further because of growing affluence and urbanization, climate change and competition for land.

Research can make a unique contribution to averting a potentially greater crisis: by increasing yields and reducing losses in crop and livestock production; by optimizing food processing, manufacture and distribution; by reducing waste and losses due to spoilage; and by understanding and addressing economic and social factors that shape consumers' needs.

As the following examples illustrate, microbiology will feature significantly. Multidisciplinary research will be particularly important, with microbiologists working alongside plant scientists, mathematicians, molecular geneticists and others to tackle problems at a systems level. We need to know more about the interactions between different micro-organisms, and between micro-organisms and plants and animals (including humans) if we are to be able to harness microbial behaviour for optimal food production and quality. Genomics-based and computational technologies will play a major role.

BACTERIAL FOES

At the University of Cambridge, Professor George Salmond's group studies the factors that trigger virulence in *Pectobacterium carotovorum* and *Pectobacterium atrosepticum*. These organisms cause significant economic losses associated with post-harvest 'soft rot' in fruits and vegetables, while *P. atrosepticum* is of particular importance in potato 'blackleg' disease in the UK. The researchers have characterized small signalling molecules associated with 'quorum sensing' – the process by which bacteria switch sets of genes on and off in response to environmental cues, particularly the density of the bacterial cell population. Quorum sensing



A rotting potato tuber showing symptoms of blackleg where bacteria have invaded the lower right side and are degrading plant tissues by enzyme action and other factors. *Blackthorn Arable*

enables individual cells to 'act in concert' in a primitive, multicellular way. In collaboration with Dr Ian Toth's group at SCRI, Dundee, the Cambridge group has defined various plant-pathological impacts of quorum sensing in these potato pathogens. Blocking quorum sensing could provide a target for new methods of disease control.

Campylobacter challenges our understanding of how bacteria adapt to different environments. Its ability to survive in its livestock host, through food production, manufacture and storage, and in the human gut makes it a serious problem along the entire food chain. *Campylobacter* is the main cause of bacterial food poisoning in Europe and America, most often contracted from eating under-cooked chicken or turkey. It is thought to cause more than 400,000 cases of food poisoning annually in the UK, costing the UK an estimated £500 million each year. An understanding of the mechanisms underlying its successful survival strategy can be expected to reveal opportunities to break the chain from host to food product, and suggest how processing and packaging might be modified so that any cells which make it that far cannot grow to dangerous levels.

At the Institute of Food Research, Dr Mark Reuter and colleagues found that on surfaces *Campylobacter* encases itself in a glue-like slime which protects it from levels of oxygen in the air that would otherwise kill it. They found that this biofilm continuously sheds cells into its environment, suggesting that it acts as a reservoir of cells that can enter the food chain or the gut.

Research by Dr Ross Fitzgerald's team at The Roslin Institute of the University of Edinburgh raises interesting questions about the spread of bacterial diseases. They showed unequivocally that a form of the disease-causing bacterium *Staphylococcus aureus* crossed from humans to chickens around 40 years ago, i.e. at a time when intensive poultry farming practices were increasing. Interestingly, the corresponding human form appears restricted to one geographical area, but the strain in chickens is found across different continents.

MODELLING: HELPING TO PREVENT EPIDEMICS AND OUTBREAKS

So-called 'systems approaches' combine experimental data and computational modelling. They help reveal how components interact in complex systems, and may be used, for example to predict where and when pathogens are most likely to strike, and which controls will be most effective. This can help farmers to eliminate prophylactic treatments and food processors to build-in product safety.

At Rothamsted Research, Dr Frank van den Bosch and colleagues modelled initial infection and spread of cassava mosaic virus, which is transmitted by whitefly and causes devastating losses of this crop which is a staple in Asia and Africa. The team examined the factors that determine the basic reproduction number (the expected number of secondary infections from a single case in a completely susceptible population). These factors include whitefly density, the genetic susceptibility of the cassava variety to the virus, and the frequency with which farmers removed infected plants (sanitation). Computer simulations showed that epidemics cannot be prevented in new crops of virus-resistant cassava if no other control is in place and whitefly densities are high; although they can be prevented at low whitefly densities. On the other hand, a combination of resistant cassava and strict sanitation can in many cases prevent the start of epidemics.

At the Institute for Animal Health (IAH), studies into the structure and genetic variation of bluetongue virus underpinned development of rapid diagnostic tests. Scientists at IAH and the Meteorological Office produced predictive models that identified where, when and which strain of bluetongue was most likely to reach the UK from the continent where it was a severe problem in 2007. As a result, vaccination of sheep in the UK was optimally timed and focused on the most vulnerable locations, helping to prevent a UK outbreak in 2008 and saving an estimated £400 million in associated costs.

IAH has also developed and commercialized a rapid test for foot-and-mouth disease virus that gives a result, on-farm, within minutes.

Computational modelling also helps the food industry ensure product safety by enabling processors, manufacturers and retailers to see how different combinations of environmental conditions influence bacterial growth. The variables can include: temperature, pH, water activity and concentration of carbon dioxide. The Institute of Food Research and the Food Standards Agency have developed a range of such predictive programs, including one for the growth of *Clostridium perfringens* during the

"Systems approaches help reveal how components interact in complex systems, and may be used, for example to predict where and when pathogens are most likely to strike, and which controls will be most effective."

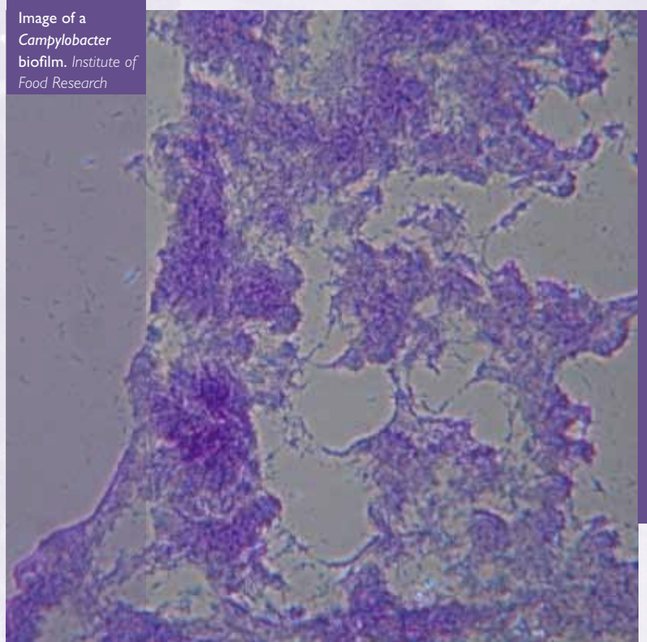
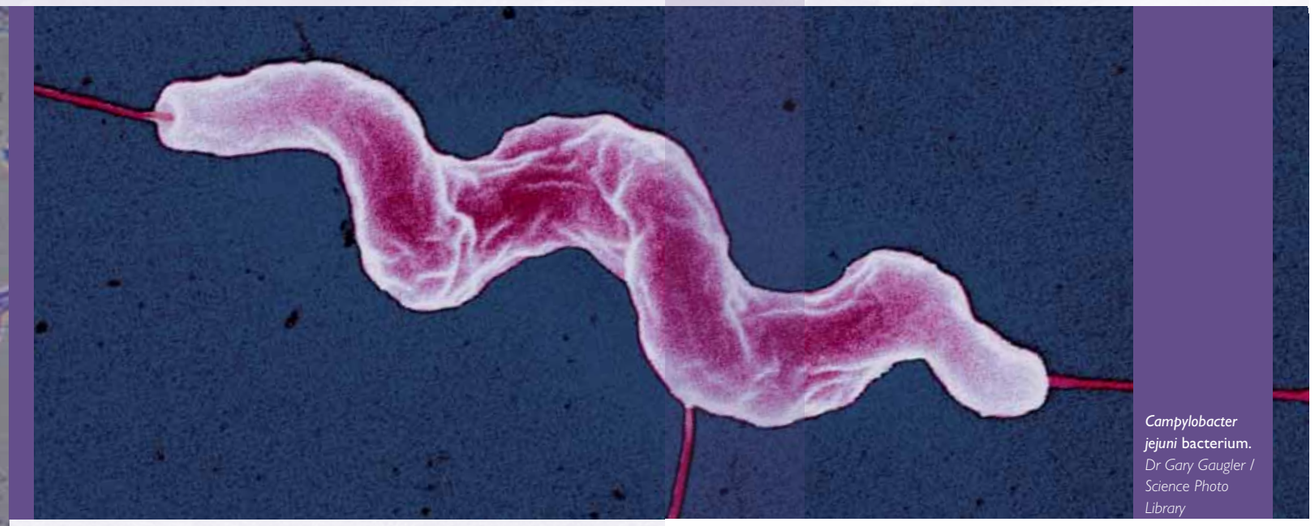


Image of a *Campylobacter* biofilm. *Institute of Food Research*



***Campylobacter jejuni* bacterium.** *Dr Gary Gaugler / Science Photo Library*

cooling of meats, and the international www.combase.cc system.

BACTERIAL FRIENDS

Many micro-organisms are essential for soil fertility and for symbiotic relationships with crop plants. Among the latter, the role of rhizobial bacteria is of particular interest. These bacteria form nodules on the roots of legumes such as peas and beans from within which they supply the plants with a usable form of nitrogen, 'fixed' from atmospheric nitrogen.

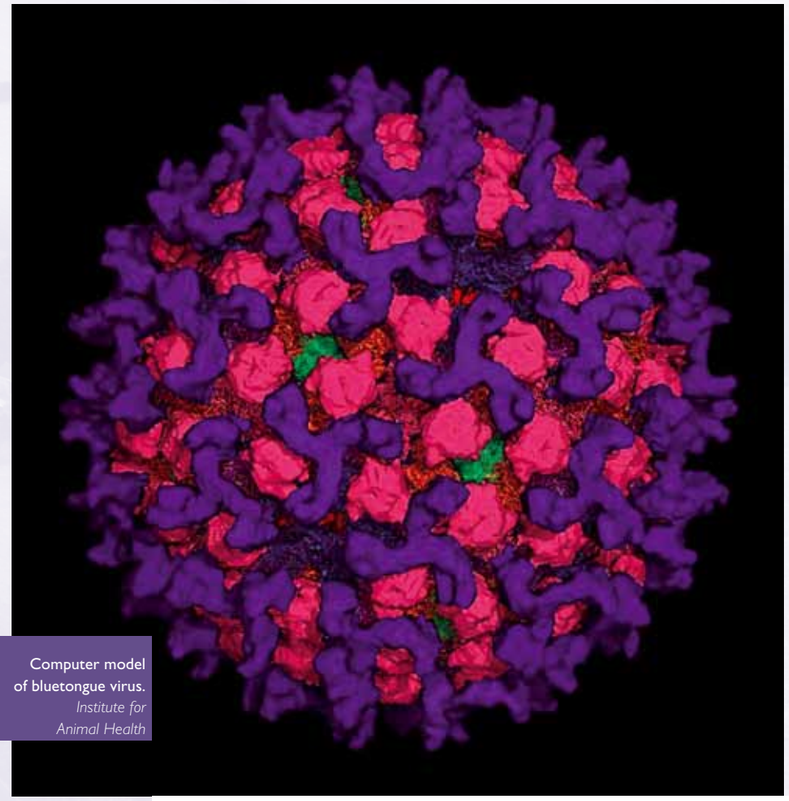
Professor Giles Oldroyd of the John Innes Centre discovered that inducing activity in a legume gene, which is essential for the plant to interact with rhizobia, triggers the growth of root nodules even in the absence of the bacteria. This is a significant step towards possibly being able to transfer nodulation and nitrogen fixation capability to non-legume crops such as cereals. Doing so would dramatically reduce reliance on inorganic nitrogen fertilizers, which would both reduce costs and remove the risk of environmental damage from fertilizer nitrogen leaching into groundwaters. It would also help overall sustainability because the energy needed to produce nitrogen fertilizers is estimated to constitute around half of all fossil fuel usage in modern agriculture.

The microflora of soils is still largely unexplored. Most of the millions of microbial species cannot be grown in the laboratory and so have been virtually impossible to study. This is changing with metagenomics – a technology for cloning genes and characterizing their function without needing to know the organisms they come from.

With funding from the Natural Environment Research Council, scientists at the University of East Anglia and Rothamsted Research have used metagenomics to explore gene functions associated with the nitrogen cycle (nitrification, denitrification and nitrogen fixation) and to determine how different agronomic practices affect the range of gene functions in soil. The approach is now being used to investigate microbial diversity in soil more generally.

At the other end of the food chain, the human gut, knowledge about microbe–microbe interactions is being used to optimize interactions between harmless bacteria that form part of the body's immune defences and invading pathogens. Opportunities are being sought to improve digestive health by using 'prebiotics' to stimulate growth of beneficial bacteria.

At the Institute of Food Research, a physical and biochemical simulator (Dynamic Gastric Model) is being used in conjunction with other studies to analyse the prebiotic potential of different compounds. Among those studied, finely ground almonds were found to increase levels of some beneficial bacteria. This study, funded by the Almond Board of California, showed the effect to be lost when fat was removed from the preparation, indicating a potential prebiotic effect due to almond lipid.



Computer model of bluetongue virus. *Institute for Animal Health*

Nitrogen-fixing nodules on the roots of a pea plant *Hugh Spencer / Science Photo Library*

"Transferring nodulation and nitrogen fixation capability to non-legume crops such as cereals would dramatically reduce reliance on inorganic nitrogen fertilizers, which would both reduce costs and remove the risk of environmental damage from fertilizer nitrogen leaching into groundwaters."

EXAMPLES OF MICROBIOLOGICAL ASPECTS OF FOOD SECURITY RESEARCH

- Maintaining and optimizing soil fertility
- Understanding the basis of host–pathogen interactions in fungal, bacterial and viral diseases of crops and livestock
- Predicting, diagnosing and pre-empting the threat posed by these diseases as they evolve in response to changing environmental factors
- Developing methods of controlling diseases that are economically, socially and environmentally sustainable
- Understanding the basis of crop and food spoilage due to microbial action and developing ways to minimize losses
- Understanding triggers for virulence
- Understanding how bacteria compete in the gut and the basis for pre- and probiotic approaches to 'swamping out' disease-causing species
- Predictive modelling of microbial growth in different food matrices, in different formulations and under different conditions, so that food processors and manufacturers can optimize product safety and shelf-life alongside nutritional quality and 'consumer appeal'

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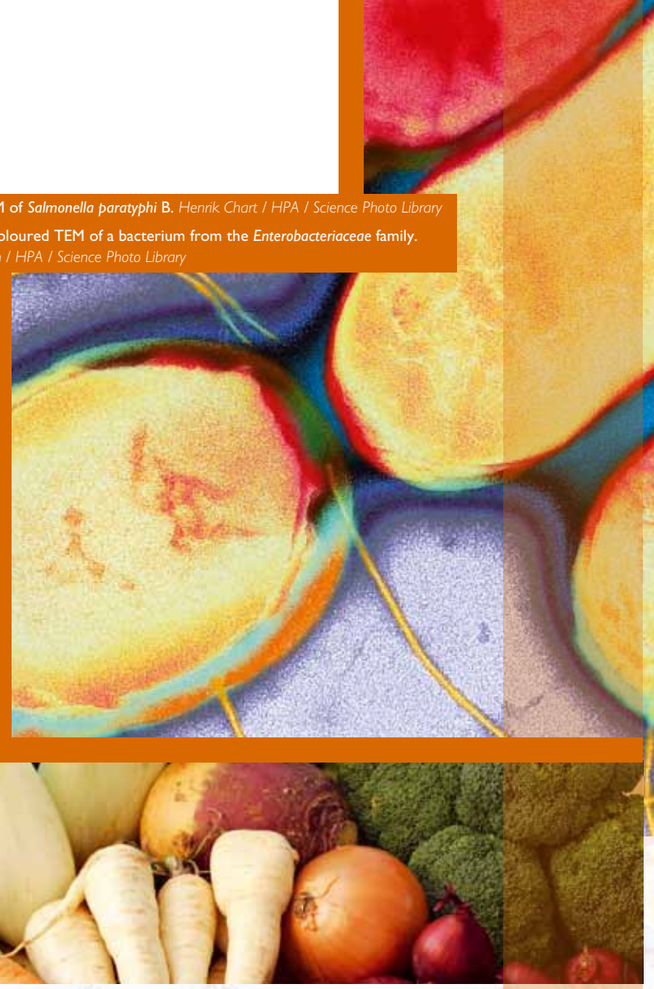
CELIA CAULCOTT is Director of Innovation and Skills, BBSRC (email celia.caulcott@bbsrc.ac.uk)

The Biotechnology and Biological Sciences Research Council (BBSRC), which invests around £200 million a year in research relevant to agriculture and food, has played a leading role in forging a unique partnership – the Global Food Security programme. This brings together UK government departments, research funders and executive agencies. The programme covers issues from primary production to retail and consumption, and encompasses disciplines across the natural, social and economic sciences. Its themes are: Economic resilience; Resource efficiency; Sustainable production; and Sustainable, healthy safe diets. See **www.foodsecurity.ac.uk**

Global Food Security
Sustainable, healthy food for all



Coloured TEM of *Salmonella paratyphi* B. *Henrik Chart / HPA / Science Photo Library*
Background Coloured TEM of a bacterium from the *Enterobacteriaceae* family. *Hazel Appleton / HPA / Science Photo Library*

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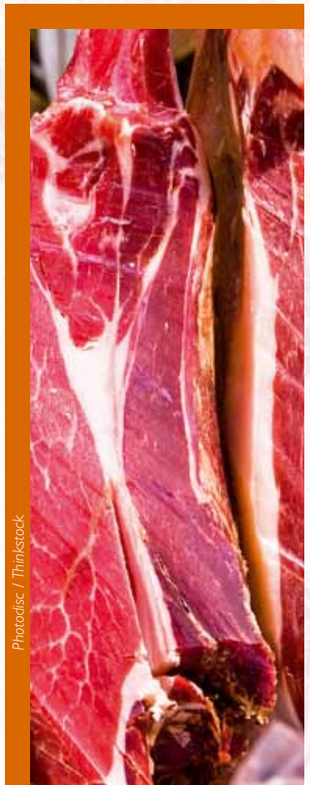
Surveillance of the microbiological quality of imported food by the Health Protection Agency



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NIAMH MURPHY

The UK is no longer self-sufficient in food production, and we are completely reliant on imported food to feed the nation. How can we be sure that the food we import is safe for human consumption?

THE FOOD CHAIN is global; ingredients used to produce a simple home cooked meal are often sourced worldwide, but this is not a new phenomenon in the UK. British store cupboards have benefited from imported food since the discovery of the new world and the introduction of potatoes into the diet in the 16th century. Extensive trade networks set up in the 17th and 18th centuries brought spices and tea from India and China, with further foods to follow. Global trade supports farmers and the worldwide economy. The global market allows alternative sources of food to be found to ensure a constant, year-round supply. Importing food has provided consumers in the UK with a cheap, plentiful and wide range of foods, although the negative effects on the environment due to transportation of foods over hundreds or thousands of miles (food miles) has raised concerns over the necessity of importing out-of-season or exotic foods purely for choice.

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IMPORTED FOOD

The UK has not been self-sufficient in food production since before World War II and is reliant on food imports to feed the population. In 2007, 25 countries were responsible for the supply of 90% of the UK's food, with the majority of food being sourced from the UK (50%) followed by the Netherlands (6.9%), Spain (5.3%), France (3.9%), Germany (2.8%) and Ireland (2.6%). The UK also exports food and drink, but currently the UK imports more food than it exports. Of all the food commodities, the

largest trade deficit is generated from importation of fruit and vegetables. The UK typically imports £6.4 billion worth of fruit and vegetables per year.

The majority of foods are shipped to the UK, but air transport is used for many perishable food items due to their short shelf lives. Imported fruit, vegetables and herbs are commonly air-freighted into the country. In 2005, 125,956 kg of herbs were imported through Heathrow Airport alone (Fig. 1). During April 2010, the supply of fruit and vegetables was under threat during the eruption of the Eyjafjallajökull volcano in Iceland. Flights to and from the UK were suspended for several days in April and again in May, stopping the movement of both passengers and air-freight, resulting in the loss of perishable foodstuffs. Importing provides a constant supply of food to feed the nation, but this food must also be safe to consume.

Foods can be unfit to eat due to spoilage or because of contamination with something that may cause illness. Foods can be contaminated with foreign objects, chemicals, poisons and infectious micro-organisms. Food-borne disease is defined by the World Health Organization as '*any disease of an infectious or toxic nature caused by, or thought to be caused by, the consumption of food or water*'. In industrialized countries, the percentage of the population suffering from food-borne diseases each year is reported to be up to 30%. In England and Wales, the Health Protection Agency (HPA) investigates outbreaks of food poisoning and collects data on food-borne illness. In England and Wales from 1992 to 2009, *Salmonella* remained the most common cause of food poisoning outbreaks at 45% of all those investigated (Fig. 2).

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The HPA performs surveillance of the microbiological quality foods in collaboration with Local Authorities for food that is on sale, and with Port Health Authorities when food enters the country. Throughout 2009, the London Port Health Authority and HPA performed a surveillance study on the microbiological quality of fruit entering the UK at the London port of Tilbury. The survey sampled apples, pears, melons, grapes, oranges, kiwi, avocados, grapefruit, clementines, peaches, grapefruit, mangoes and coconuts for contamination with *Salmonella* species. Out of 186 samples, no contamination was detected. Data from surveys and routine sampling is used as part of risk assessment of foods and processes in a proactive approach to control the risk of contaminated food entering the market.

THE EUROPEAN RAPID ALERT SYSTEM

To ensure food safety, it is necessary to look beyond UK borders, as food-borne pathogens navigate the globe in food, animals and people. In Europe, the Rapid Alert System for Food and Feed (RASFF) warns member states using alert notifications when a food or feed presenting a serious risk is available for sale. The RASFF also provides information notifications when a risk has been identified, but the product is no longer on the market, and border rejections to notify member states that a food or feed has been refused entry to the EU. In 2008, 24% of all alert notifications were due to contamination of foods with potentially pathogenic organisms, *Salmonella* contamination being the most common bacterial alert notification.

In 2009, a large outbreak of *Salmonella* food poisoning in the UK was investigated and resulted in a RASFF alert notification. On 25 September 2009, the HPA noted a national increase in *Salmonella enterica* serovar Enteritidis phage type (PT) 14b infections. The isolates were predominantly resistant to naladixic acid (Nx), and exhibited low-level resistance to ciprofloxacin (Cpl).

Fig. 1. **Food of non-animal origin imported via Heathrow in 2005.** *Adapted from www.defra.gov.uk*

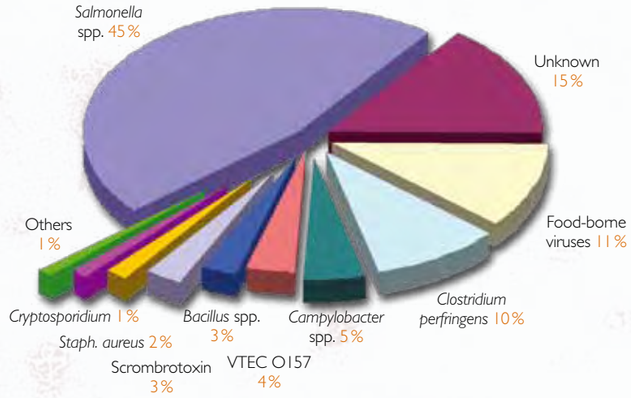

Fig. 2. **Number of food-borne outbreaks attributed to a causative organism in England and Wales, 1992–2009 (VTEC, verocytotoxic *Escherichia coli*; others, mixed infections and *Listeria monocytogenes*).** *Adapted from www.hpa.org.uk/Topics/InfectiousDiseases/InfectionsAZ/GastrointestinalDisease/EpidemiologicalData/*

The HPA investigated the cases and found 16 discrete *S.* Enteritidis PT 14b NxCpl outbreaks across England and Wales. Investigations showed that in five of the outbreaks (three in oriental restaurants and two in cafes), *S.* Enteritidis PT 14b NxCpl was present in eggs collected from the catering premises and were produced from the same approved establishment in Spain (as indicated by the distinguishing egg stamp mark on shell eggs). Subsequent sampling of eggs from the same producer in Spain, supplied to a UK distributor, took place in November and *S.* Enteritidis PT 14b NxCpl was detected in two (2.5%) of the 80 pooled samples of 480 eggs tested (6 eggs per pool).

S. Enteritidis PT 14b NxCpl isolates were obtained from environmental and food samples that were tested as part of the outbreak investigations and from eggs sourced from the producer in Spain. Molecular diagnostic testing of the food and environmental isolates indicated that they were indistinguishable from isolates obtained from human cases both from the outbreaks and from sporadic cases of infection during the same period. The Food Standards Agency (FSA) notified the European Commission and other member states about the contaminated eggs sourced from Spain using the RASFF system. The FSA and the Spanish authorities have subsequently ensured that eggs laid by the affected flock and intended for human consumption are heat-treated to destroy any *Salmonella* and not sold as shell eggs. This case illustrates how good communication throughout Europe removed a contaminated food product from the market and prevented further illness. The outbreak investigation is described in the *Health Protection Report* (vol. 4, part 6, 12 February 2010).

"The UK has a proactive approach to surveillance of food-borne illness, monitoring the microbiological quality of food on sale and performing risk assessment."

Coloured TEM of a bacterium from the *Enterobacteriaceae* family. *Hazel Appleton / HPA / Science Photo Library*

PROACTIVE SURVEILLANCE

Importing foods continues to provide consumers in the UK with a constant, cheap, plentiful and wide range of foodstuffs. It is important to note that most of our food does not cause illness, wherever it is produced. The UK market requires a high standard of microbiological food quality, which is applied to all foods irrespective of the country of production. The UK has a proactive approach to surveillance of food-borne illness, monitoring the microbiological quality of food on sale and performing risk assessment. Proactive surveillance provides essential information on the safety of food, the amount of food-borne illness, hazards and risks. Data from surveillance is used for intervention measures and food safety management.

Communication between government agencies and with Europe is also essential to reducing the risk from food poisoning. Surveillance, along with hazard analysis of critical control points (HACCP) and legislation are some of the measures employed to help reduce the numbers of cases of food poisoning in the UK.

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FURTHER READING

www.hpa.org.uk/Topics/InfectiousDiseases/InfectionsAZ/GastrointestinalDisease/EpidemiologicalData/FoodborneOutbreakSurveillanceAndRiskAssessment/
http://ec.europa.eu/food/food/rapidalert/report2008_en.pdf
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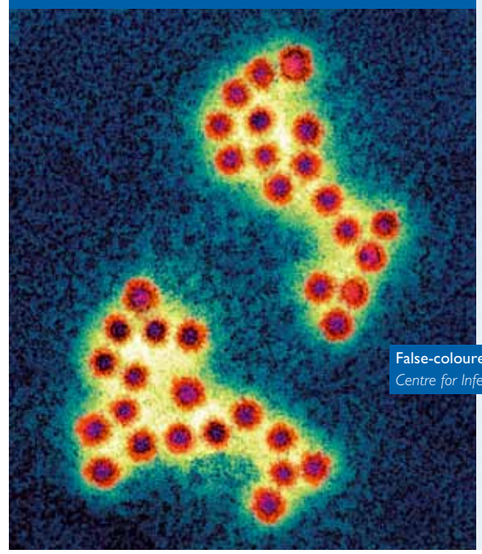


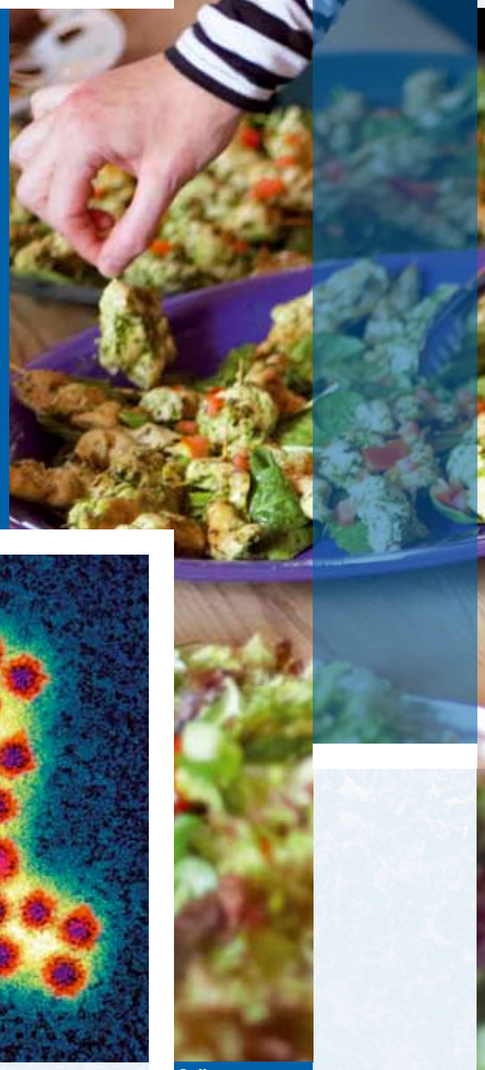
False-coloured TEM of Norovirus particles.
Centre for Infections / HPA / Science Photo Library

IAN GOODFELLOW

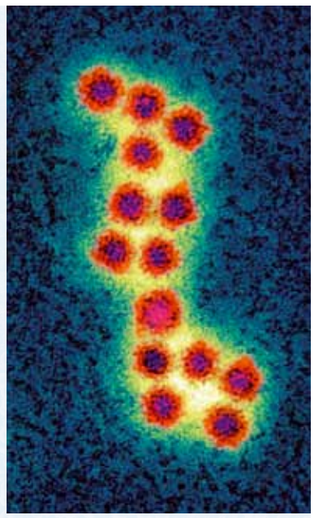
DAVID BROWN

Beware the buffet: noroviruses as a cause of food-borne gastroenteritis

Even if we have never succumbed to it, we are all familiar with the sickness caused by noroviruses due to high-profile media coverage of outbreaks in various closed communities, such as hospitals and cruise ships. But how extensive are noroviruses in our food chain and what can be done to prevent outbreaks in future?



Buffet.
Photos.com / Thinkstock



NOROVIRUSES are small RNA viruses which cause a disease which comes under many guises, including 'Winter vomiting disease' and 'Stomach flu'. The disease is characterized by rapid-onset gastroenteritis, often associated with particularly violent episodes of 'projectile' vomiting. Usually self-resolving, the vast majority of people recover after 1–2 days of illness, although immunocompromised individuals may excrete virus for many months. Although noroviruses are typically associated with gastroenteritis, they have been associated with more severe clinical diseases, such as necrotizing enterocolitis in newborn infants, renal failure and benign convulsions in children, as well as the exacerbation of inflammatory bowel disease.

Noroviruses are very efficient pathogens as only a very small dose is required to establish an infection; some estimates put it as low as 10 virus particles. Noroviruses are typically spread by direct person-to-person contact, but also by contact with contaminated materials (including ingestion of contaminated food) and by the nature of the vomiting episodes (ingestion/inhalation of aerosolized vomit). This makes the virus particularly effective in closed environments such as hospitals, cruise ships, military camps and care homes.

NOROVIRUSES IN THE FOOD CHAIN

The US Centers for Disease Control and Prevention (CDC) has shown that >50% of all food-borne outbreaks of gastroenteritis can be linked to noroviruses, and in Europe it is estimated that >80% of all non-bacterial food-borne outbreaks of gastroenteritis are due to noroviruses. Best estimates suggest that around 23 million cases of norovirus gastroenteritis occur each year in the US, and >1 million in the UK. However these are likely to be underestimates as the majority of people infected with noroviruses are never formally tested for the virus. Recent data would also

"Until such times that vaccines and/or antivirals are available, good hygiene and common sense are the most effective protection against norovirus infection."

Warning sign alerting members of the public to possible contamination of shellfish. *Hazel Appleton, VRD*

indicate that asymptomatic norovirus infections are also common; between 1993 and 1996, up to 12% of the UK population were excreting low levels of norovirus RNA at any one time.

Noroviruses can enter the food chain at many points as food can be contaminated during preparation or at source. Unlike bacteria, viruses do not grow in food; therefore food becomes contaminated with noroviruses only through contact with faecal matter or in some cases vomit. Whilst outbreaks due to contaminated soft fruit, such as raspberries, or lettuce are recognized, many other types of food have been linked to noroviruses. The most notorious source of norovirus outbreaks is bivalve molluscs, with oysters as the primary culprit as they tend to be eaten raw or only lightly cooked. Typically, shellfish become contaminated due to exposure to sewage-polluted water, and as filter feeders they effectively concentrate the virus particles in their tissue where the virus is very stable. Noroviruses are inherently stable, remaining infectious even in frozen or refrigerated food. Therefore, unless cooked well, ingestion of contaminated shellfish results in exposure to large doses of virus, causing rapid gastroenteritis. Indeed, one of the most widely publicized recent food-borne norovirus outbreaks, that at an internationally acclaimed restaurant in Berkshire in 2009, was reportedly due in part to contaminated shellfish. Often shellfish are contaminated with multiple norovirus isolates, which increases the chances of generating novel noroviruses through the recombination of the viral genomes in infected consumers. The most common cause of norovirus contamination of food is via food handlers, and unless food is subsequently cooked well after contamination, it becomes an efficient infection source. Contaminated serving utensils, often shared at buffets, also provides a very effective method of rapidly spreading noroviruses.

NOT ALL NOROVIRUSES ARE EQUAL

Since 2000, a new variant of norovirus has emerged, known as genogroup type II.4, and is now dominant. Over the past 10 years it has become clear that variations in the carbohydrate structures present on the surface of cells lining the intestine are a major determinant of a person's susceptibility to norovirus infection. In general terms, noroviruses have the ability to infect everyone; however, many isolates are less likely to infect people which have a mutation in a particular gene (*FUT2*) involved in the addition of a sugar, known as α-2-linked fucose, to the proteins present on the cell surface. This in part explains why in some outbreaks individuals may be exposed to the same virus, i.e. by consumption of the same food, yet only some of them become infected. The reasons why genogroup II.4 viruses have largely dominated in recent years is not fully understood, but one idea recently put forward is that this virus has a better ability to mutate away from any type of immune response. Therefore, genogroup II.4 viruses evolve rapidly, allowing antigenic drift as occurs in influenza virus.

Oyster. *Stockbyte / Thinkstock*

Background **Computer artwork of the capsid of the Norwalk virus.** *Laguna Design / Science Photo Library*

PREVENTION IS BETTER THAN CURE

There are currently no licensed vaccines or antiviral treatments for noroviruses. Therefore, the recommended guidance is to ensure appropriate hydration and to stay at home until 48 hours after symptoms have resolved. This is particularly relevant for food handlers who can remain infectious for several days even after symptoms have finished. Whilst vaccine candidates are currently under trial, it is generally accepted that long-term immunity to noroviruses does not occur. Cross-protection against norovirus strains, i.e. heterotypic protection, has not been demonstrated. As noroviruses appear to evade any host immune response, new viruses appear regularly due to antigenic drift. Should the vaccine candidates provide at least short-term protection, it is attractive to imagine a scenario whereby new vaccines would be produced yearly, directed against the currently circulating isolate, and which may give protection for only a short period. Such a vaccine or vaccines would be particularly attractive to individuals about to embark on a once in a lifetime cruise, and may go some way to protect the NHS against the vast economic burden of norovirus outbreaks within hospitals which are estimated to cost >£100 million per year.

Surprisingly, although a lot of sanitizing hand gels and disinfectants claim to be effective against noroviruses, it is not unusual to discover that they have never actually been tested against them. Because human norovirus particles cannot currently be grown in the lab, there is no method of measuring the amount of infectious norovirus surviving after using one of these products. In fact, most have only ever been tested against a related cat virus known as feline calicivirus. Feline calicivirus, although widely used for these studies, is a respiratory virus and is unstable in acidic environments; noroviruses, on the other hand are stable in acidic conditions, having to survive the harsh environment of the stomach. Therefore, whether products which inactivate feline calicivirus will be effective against human noroviruses is debatable. Recently, however, a mouse norovirus, also an intestinal pathogen, has been increasingly used to test these products as this is more likely to show similar stability to human noroviruses. Until this becomes common practice, these products should probably be used with caution and should not be used as a substitute for good hygiene practices.

FUTURE PROSPECTS

In the catering industry, education of food handlers is key. Clear guidelines for good practice in food preparation need to be strictly adhered to and policed. Whilst it is generally accepted that there remains an ongoing risk from oysters, etc., since sewage contamination of estuarine waters is likely to continue and depuration is ineffective for viruses, the development of sensitive screening procedures for identifying contamination has the potential to reduce the risk. Further improvements in decontamination of contaminated food and environmental settings will undoubtedly aid in minimizing the effects of norovirus contamination and outbreaks. Until such times that vaccines and/or antivirals are available, as consumers, good hygiene and common sense are the most effective protection against norovirus infection, i.e. increased hand washing, as well as avoidance of shared food sources/utensils and pre-prepared food during outbreaks.

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GAIL M. PRESTON
DAWN L. ARNOLD

Karma chameleons: how bacterial plant pathogens escape their fate in disease-resistant plants

The immune system of plants can be unstable in the face of rapidly evolving micro-organisms, and pathogens that can evade recognition can spread with alarming speed through a plant population. What is the reason for this inherent instability, and how can disease control be improved?

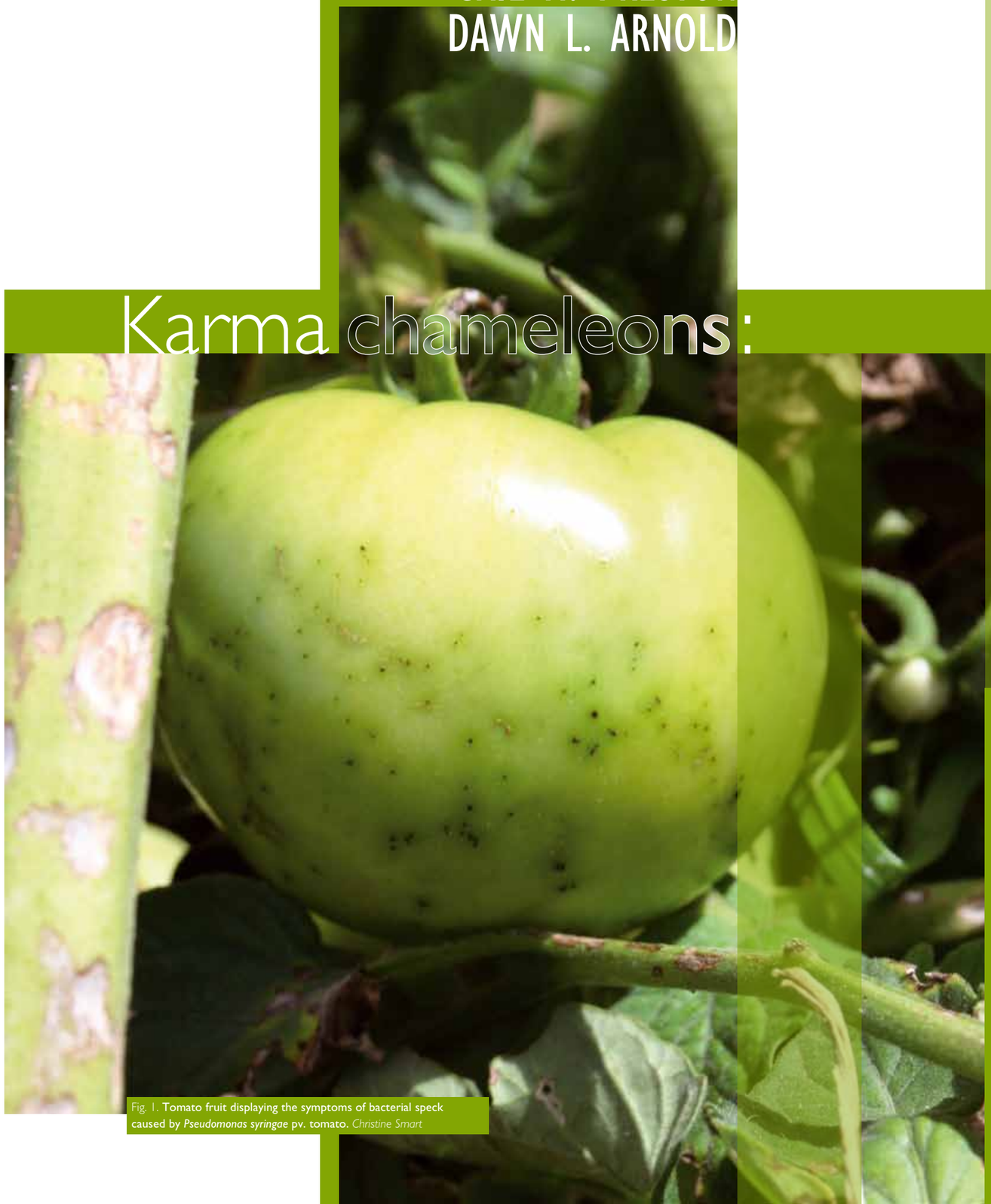

Fig. 1. Tomato fruit displaying the symptoms of bacterial speck caused by *Pseudomonas syringae* pv. tomato. *Christine Smart*

PLANTS, UNLIKE ANIMALS, lack an adaptive immune system that allows them to recognize and defend against novel pathogenic micro-organisms. Instead they rely on a heritable, innate immune system in which plant receptors recognize the presence or activity of microbial molecules known as elicitors. Plants exposed to infection can increase the effectiveness of their immune system by increasing the speed and strength of their defence mechanisms. However, pathogens that have the ability to evade recognition can spread rapidly through plant populations. The instability of receptor-dependent resistance in the face of rapid microbial evolution creates one of the most fundamental challenges in plant breeding. In this article we discuss why receptor-dependent resistance breaks down in the face of pathogen evolution and consider whether knowledge of pathogen evolution can provide insights to improve disease control.

THE 'ZIG-ZAG' MODEL OF PLANT DEFENCE

The evolution and function of the innate immune system in plants is commonly described in terms of the 'zig-zag' model proposed by Jones & Dangl. Many of the features of this model have arisen from research into the bacterium *Pseudomonas syringae*, strains of which cause necrotic and chlorotic symptoms on plant foliage and fruit, and galls and cankers in woody tissues. Most pathogenic strains of *P. syringae* are highly host-specific, and they are commonly classified into groups known as pathovars, which infect a particular plant species, or group of plant species. Pathovars may be further subdivided into races, which infect specific cultivars or varieties within a plant species.

The zig-zag model explains this specificity in terms of a genetic arms race between plant and pathogen. The arms race begins with plant

Fig. 2. Tomato leaf infected with *Pseudomonas syringae* pv. tomato, showing necrotic and chlorotic symptoms. *Christine Smart*

"The distribution, structure and function of P. syringae *effectors is highly dynamic, and bacteria can evade plant recognition by losing or modifying effectors that are subject to plant recognition."*

Fig. 3. Bean leaves inoculated with *P. syringae* pv. phaseolicola, the causal agent of halo blight of bean, showing disease symptoms (left) and the HR. These leaves have been inoculated with high densities of bacteria so that the defence-associated cell death associated with the HR occurs on a large scale and is clearly visible. *Helen Lovell*

recognition of bacteria-specific molecules, which are recognized as elicitors by plant receptors, commonly referred to as pattern recognition receptors (PRRs). Many of these molecules are also recognized by receptors involved in animal innate immune systems, and they are commonly known as PAMPs (pathogen-associated molecular patterns). When plant receptors interact with PAMPs, this initiates an immune response known as PAMP-triggered immunity (PTI), resulting in the production of defence mechanisms that limit pathogen growth. Pathogens affected by PTI have three options: to lose PAMPs, to modify PAMP structure so that they are no longer recognized, or to acquire a means of disabling PTI. Losing PAMPs is generally not an option, as these are often essential for processes such as motility and cell viability. Thus, for *P. syringae* a key 'zag' to counteract the PTI 'zig' is the production of effectors, bacterial proteins that are injected into plant cells through a molecular syringe known as a type III protein secretion system (T3SS). Many effectors secreted by the *P. syringae* T3SS are known to disable PTI, resulting in effector-triggered susceptibility (ETS).

If PTI is rendered ineffective by the action of *P. syringae* effectors, plants are highly vulnerable to infection, so the zig-zag model incorporates a further step of plant evolution, in which plants evolve a new generation of surveillance mechanisms that recognize either effectors or their activities. Effector recognition initiates a strong defence response, for example the hypersensitive response (HR), which results in localized production of antimicrobial metabolites and localized cell death. In race-specific interactions between plants and *P. syringae*, the difference between disease and disease resistance may be just one plant gene or one plant effector. This has led researchers to refer to this form of plant immunity as gene-for-gene resistance or monogenic resistance, although more recently it has become increasingly known as effector-triggered immunity (ETI). ETI, like PTI, selects for a countermove by *P. syringae* in which effectors recognized by plant receptors are lost, or new effectors suppressing ETI are gained. Modern *P. syringae* strains are thought to be the products of an extended evolutionary arms race, resulting in bacteria that carry an arsenal of effectors and plants that express a wide variety of PTI- and ETI-linked receptors.

THE EVOLUTION OF *P. SYRINGAE* EFFECTOR PROTEINS

Much of our existing knowledge of effector evolution has come from studies of plant pathogen genomes, which allow researchers to infer from DNA sequence data how effector repertoires may have changed over time. Genome analyses, supported by experimental studies of effector function, have revealed several key features of *P. syringae* effectors that strongly support the zig-zag model outlined above. First, *P. syringae* genomes have been found to contain a mixture of functional and non-functional effector genes. Second, the effector complement of even closely related *P. syringae* strains has been found to be highly divergent. Almeida and colleagues compared the genome of the tomato pathogen *P. syringae* pv. tomato DC3000 (Pto DC3000) to the genome of the closely related strain *P. syringae* pv. tomato T1 (Pto T1) and found that of 29 predicted effectors in Pto DC3000, only 14 were also present in Pto T1, which contained 11 T1-specific effectors. T1 also contained non-functional versions of effector genes present in DC3000, and both strains contained additional DNA sequences thought to correspond to non-functional effectors.

Further evidence for the evolution of effectors in the face of plant selection has been provided by a recent study of the distribution and function of the gene encoding the effector AvrPto in 19 strains of *P. syringae* pv. tomato isolated in California, where tomato plants containing the Pto resistance gene for ETI to bacteria producing AvrPto have been grown for more than 20 years. Researchers found that AvrPto was present in only a small subset of strains, and that these strains expressed a variant of AvrPto that was not recognized by plants. This indicates that the distribution, structure and function of *P. syringae* effectors is highly dynamic, and that bacteria can evade plant recognition by losing or modifying effectors that are subject to plant recognition.

However, an arms race based solely on pathogen disarmament in the face of plant recognition would not sustain plant pathogenesis in the long term. A final feature of *P. syringae* that indicates they are subject to rapid evolution, and importantly to both loss and gain of effectors, is that many effector genes are present in genomic islands, stretches of DNA present in certain strains, indicating that effectors are part of a mobile gene pool. An arms race in which pathogens can discard effectors, evade recognition and re-acquire 'next-generation' versions of previously discarded effectors makes pathogens such as *P. syringae* challenging foes.

P. SYRINGAE PV. PHASEOLICOLA – SACRIFICE AND SALVAGE

The studies outlined above provide indirect evidence of effector evolution in *P. syringae*, examining the legacy of generations of plant–pathogen interactions over many years. Recent work by Arnold and colleagues has provided direct evidence of pathogen evolution in response to plant immune responses, illustrating the real-time dynamics of effector gene loss and gain in the bean pathogen *P. syringae* pv. phaseolicola (Pph). Some strains of Pph carry the effector gene *avrPphB* (also named *hopAR1*), which activates ETI in commonly grown bean cultivars such as Tendergreen (TG). Researchers noticed that very occasionally an isolate of a Pph strain that carries *avrPphB* failed to elicit defence responses on TG, and instead was able to cause disease. Further investigation showed that not only was *avrPphB* absent from these isolates, but also a large region of DNA surrounding it. This region of DNA was found to be around 106 kb in length and to contain 100 genes. It contained many of the features of a genomic island (GI), and was named PPHGI-1. Further work showed that loss of PPHGI-1 could be induced in the laboratory, but only if a strain carrying PPHGI-1 was inoculated into the leaves of the resistant cultivar TG. The island was very rarely lost when inoculated into a susceptible bean cultivar and almost never lost *in vitro*. Interestingly, the highest number of bacteria lacking PPHGI-1 was recovered from

Fig. 4. Bean pods inoculated with strains of *Pseudomonas syringae* pv. phaseolicola in order to identify strains that elicit or fail to elicit the HR. In this assay, the HR appears as a brown sunken lesion, while disease symptoms have the appearance of a green, water-soaked lesion. *Helen Lovell*

plants inoculated with a low density of bacteria. This suggested that defence mechanisms in the TG bean plants were driving the evolution of new virulent forms of the pathogen, but that virulent strains could only thrive when they were able to escape the inhibitory effect of the HR. At high densities, the strong HR elicited by high numbers of bacteria containing PPHGI-1 inhibited further proliferation of virulent strains.

PPHGI-1 was shown to form a circular molecule when excised from the chromosome, which could be lost from bacterial cells, or re-inserted into the genome. This raises the question as to whether this circular intermediate could be transferred between bacteria during growth in plant leaves, allowing strains of *P. syringae* to acquire it, or allowing bacteria that had previously lost PPHGI-1 to re-acquire it. To investigate this, a strain containing PPHGI-1 (Pph 1302A) was co-inoculated into leaves with a second strain, Pph 1448A, which lacked PPHGI-1. After 3 days in the plant, the recipient strain had PPHGI-1 integrated into the genome. This meant that strain 1448A, which originally could cause disease on TG, now triggered the HR because it was now producing AvrPphB. The mechanism of transfer was shown to be transformation as Pph 1448A was found to be capable of acquiring both PPHGI-1 and other DNA molecules directly from the environment, or from dead bacterial cells. Paradoxically, transformation occurred at highest frequencies when Pph 1302A and Pph 1448A were inoculated into TG leaves, where acquisition of PPHGI-1 might be expected to restrict growth of Pph 1448A. This suggests that transformation mechanisms in *P. syringae* are activated in response to plant defences.

PROSPECTS FOR DURABLE DISEASE RESISTANCE

Studies of effector distribution and function in *P. syringae* have shown that the effectors used by these bacteria to disable plant defences are structurally diverse and rapidly evolving. Work on the effector-carrying genomic island PPHGI-1 has shown that effectors can be lost from *P. syringae* in response to the stress of ETI, and that *P. syringae* can acquire DNA within plants. This has important implications for the use of resistant cultivars to achieve disease control. Resistance based on a single effector recognition event may rapidly break down in the face of pathogen evolution, driving the evolution of variant effectors, the transfer of variant effectors between strains and the loss of effectors from bacterial populations. However, when growers plant new cultivars lacking these obsolete resistance genes, bacteria may be able to re-acquire effectors present at low frequencies in bacterial populations, bringing them back into play. Durable disease resistance may only be achieved using plants which carry multiple resistance genes targeting multiple effectors and PAMPs, so that mutations at a single locus cannot overcome plant defences, by modifying plant targets to block bacterial interference, or by using novel resistance mechanisms for which bacteria have not yet evolved a counter-strategy.

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FURTHER READING

The *Pseudomonas*–Plant Interaction website (http://pseudomonas-syringae.org/) provides extensive information on *P. syringae* genome sequencing projects and biology. It also contains a *High School Connect* webpage with information and resources for teachers and students describing how plant pathogens infect host tissues and how plants defend themselves from pathogen attack.

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The 8th International Conference on P. syringae *and related pathogens will be held in Oxford between 31 August and 3 September 2010. To find out more, visit* ***www.reading.ac.uk/psyringae2010/***

"An arms race in which pathogens can discard effectors, evade recognition and re-acquire 'next-generation' versions of previously discarded effectors makes pathogens such as P. syringae *challenging foes."*

MOGENS JAKOBSEN

PathogenCombat – reducing food-borne disease in Europe

PATHOGENCOMBAT is an Integrated Project of the 6th European Union Framework Programme. The project began in 2005 and has 40 partners, including 12 small- and medium-sized companies (SMEs) comprising food-producing and biotech enterprises as well as consultants to the food industry.

Although food production in Europe has never been more stringently controlled, consumers still suffer from food-borne diseases. There have been significant investments by governments and the food industry to ensure food safety, yet these have not been wholly successful. Besides being of fundamental importance to the consumer, food safety is vital to the food industry and economy, as failures impact substantially on trade and competitiveness.

Fig. 1. **A series of images (from left to right) showing the detachment of a single yeast cell from the bottom of a glass bead using optical tweezers.** *Henrik Siegumfeldt, Frederiksberg, Denmark*

To provide information on control and prevention of emerging pathogens at the cellular and molecular level throughout the food chain, a 5-year EU-funded project, *PathogenCombat*, was set up in 2005. As this project nears its end, what has it achieved?

The main objective of *PathogenCombat* has been to supply essential new information and methods to the food industry and public authorities on how to reduce the prevalence of pathogens. This article summarizes the microbiological targets and outputs of *PathogenCombat*.

THE PATHOGENS

A versatile profile of emerging pathogens was selected to provide models to control the unknown pathogens of the future. The pathogens studied were: two Gram-positive bacteria, *Listeria monocytogenes* and *Mycobacterium avium* subsp. *paratuberculosis*; two Gram-negative bacteria, *Campylobacter jejuni* and pathogenic *Escherichia coli*; an invasive variant of *Saccharomyces cerevisiae*; ochratoxin A-producing *Penicillium nordicum*; and two viruses, hepatitis E virus (HEV) and tick-borne encephalitis virus (TBEV). Finally, detection and prediction of the formation of *Staphylococcus aureus* enterotoxins in food were addressed. A major achievement of *PathogenCombat* has been the development of molecular methods for the detection of these pathogens in food, a process which has also provided information on their behaviour in the food chain.

NEW BIOTECHNOLOGICAL PLATFORMS TO MONITOR THE BEHAVIOUR OF PATHOGENS

Novel methods have been developed to analyse interactions at the cellular and molecular level between pathogens, food and food matrices, as well as contact surfaces in the food chain, including the intestinal tract of farm animals. These methods were selected to obtain an understanding of the mechanisms by which pathogens enter, adapt, persist and express virulence mechanisms throughout the food chain. Particular emphasis has been given to an 'optical tweezer' method developed in the project (Fig. 1), Fluorescence Ratio Imaging Microscopy (FRIM), atomic force microscopy (AFM), functional genomics and functional mammalian cell models. Some methods, such as the optical tweezers, allow single-cell studies of microbial attachment and de-attachment to surfaces, and have been used here for the first time in food microbiology. FRIM has been extensively used in the project to monitor viability and activity of single cells of pathogens by determination of intracellular pH. The results obtained have challenged the traditional use

of measuring the number of colony-forming units to determine pathogen survival. AFM has also been applied in studies of interactions between pathogens and food contact surfaces, persistence of pathogens, resident micro-populations and biofilm formation. These studies, including the use of molecular, culture-independent techniques, have demonstrated that pathogens in biofilms or just attached to food contact surfaces can become more resistant and virulent. These techniques are also useful for determining viable but non-culturable micro-organisms which cannot be detected by conventional analyses. *PathogenCombat* also demonstrated that for virulent and resistant pathogens as sources of contamination there is a need to use methods derived from recent developments in functional genomics.

In addition, mammalian functional cell models (see Fig. 2) based upon true epithelial cells have been developed in *PathogenCombat* for pigs, chickens and ruminants. They were used to study host–pathogen interactions and for the selection of protective and probiotic cultures to help protect against pathogens, including viruses.

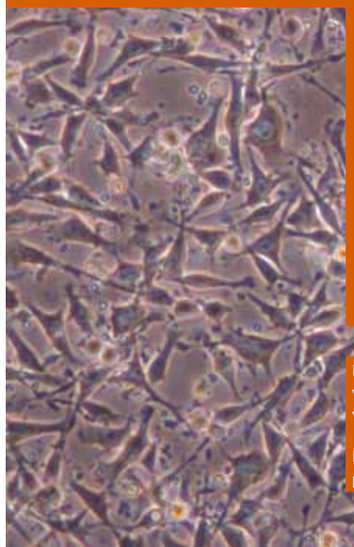
RAPID AND MEANINGFUL DETECTION METHODS

Culture-independent techniques have been developed to aid the study of food-borne pathogens. The methods are not only quantitative but they also estimate virulence of pathogens throughout the food chain. As an example, the profiles of *E. coli*-associated virulence genes in the food chain have been monitored by quantitative PCR (qPCR) for lamb from slaughterhouses to butcheries. Comparisons have also been made between the number of *E. coli* cells determined by qPCR and by conventional culturing methods. Significant weaknesses of conventional methods were highlighted, and qPCR was shown to be a more sensitive method than the plate-based methods. The difference between the two methods was particularly pronounced for environmental samples, for example from lamb meat contact surfaces. Quantification of bacteria by qPCR also showed more reliable and higher counts than the conventional culture-based methods. This suggests that the conventional methods may simply overlook important sources of pathogen contamination, for example poor hygiene, equipment design or ineffective cleaning and disinfection. Such information is useful for determination of routes of contamination and is valuable in risk assessment. To shorten detection time, a capture technique based on phage proteins was developed by *PathogenCombat*, using culture enrichment combined with phage proteins to capture pathogens. This resulted in a detection time of 6 hours for food samples (Fig. 3).

NOVEL STRATEGIES

PathogenCombat has lead to novel strategies for food formulation, food preservation and quantitative risk assessment. It is current practice to use the number of pathogens to predict the danger of food-borne disease and to formulate safe food. However, food-borne pathogens can express virulence factors under conditions which do not allow for growth, and conversely growth can occur under conditions where virulence genes are repressed. This led to molecular approaches being developed to study ochratoxin A biosynthesis by *P. nordicum* and formation of enterotoxin A by *S. aureus*. DNA microarrays were developed for determination of expression profiles of virulence-associated genes in *L. monocytogenes*, *C. jejuni* and *E. coli*.

The DNA microarray for *L. monocytogenes* has also been used in a food system to study virulence expression patterns



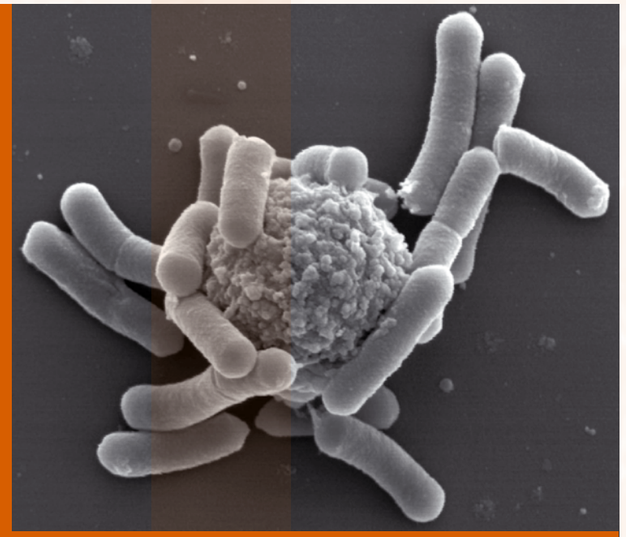


Fig. 2 (left). **A goat monocyte macrophage cell line (GOMA), developed for the first time within *PathogenCombat*. These cells have been used in studies of transmissible gastroenteritis virus (TGEV) infection and prevention.** *Avrelija Cencic, Maribor, Slovenia*

Fig. 3 (above). **Electron micrograph showing a magnetic bead coated with *Listeria*-specific phage protein binding *Listeria monocytogenes* (Listeria Capture kit).** *Hyglos GmbH, Germany*

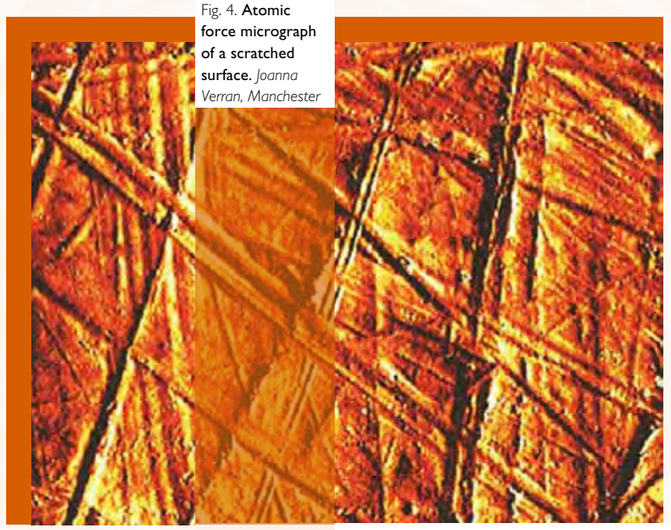


Fig. 4. **Atomic force micrograph of a scratched surface.** *Joanna Verran, Manchester*

using high-throughput methods, and testing for survival under conditions simulating the gastrointestinal tract and food processing, a total of 25 novel protective and probiotic strains were selected and tested thoroughly. Candidate strains for breaking the transmission of *C. jejuni* at farm level were identified for chicken, as were strains with antiviral activity. Many of these tests were carried out using functional cell models developed in other work packages within *PathogenCombat*.

EFFECTIVE FOOD SAFETY MANAGEMENT SYSTEMS (FSMS) ARE A CONDITION FOR SAFE FOOD

The importance of FSMS to microbiologists is clear. However,

"A major achievement of PathogenCombat *has been the development of molecular methods for the detection of pathogens in food."*

in complex matrices. The microarrays are seen as valuable tools in risk assessment studies for modelling of gene expression profiles for pathogens exposed to different environmental stresses in model systems and food.

CLOSING THE GAP BETWEEN TECHNOLOGY AND HYGIENE

It would appear that a major reason for the high incidence of food-borne disease and the failure of the situation to improve is explained by poor design in food industry equipment. Visits to companies throughout Europe have indicated that more than 80% of new *Conformité Européenne* (CE)-marked food process equipment did not comply with official hygiene provisions of the European Machinery Directive (2006/42/EC). This problem has been addressed in *PathogenCombat* and the results obtained are being presented and distributed in brochures providing information to industry to allow successful intervention and preventive strategies to be implemented. The research focused on factors which can make certain pathogens persist in a particular factory, and on how to make surfaces and machinery easier to clean. For example, a technique was developed to take impressions of new and in-use surfaces to enable the features to be measured using AFM, which gives very high resolution images (Fig. 4). These investigations can provide important information on the design of new surfaces that might facilitate improved properties in terms of cleaning.

INACTIVATION OF PATHOGENS BY MILD PROCESSING TECHNIQUES

To break the transmission of pathogens along the food chain, several techniques have been investigated. Among the successful techniques was the use of intensive light pulses (ILP) to decontaminate knives, etc., in slaughter houses, and ILP combined with packaging in modified atmospheres to control *Campylobacter* in chicken meat. Hydrostatic pressure in trials with model virus was indicated to be effective in inactivating HEV in food.

NEW PROTECTIVE AND PROBIOTIC CULTURES FOR CONTROL OR ELIMINATION OF PATHOGENS

Following screening of more than 1,000 strains for antimicrobial activity, consumer and industry trust in microbiological testing to control pathogens and to provide appropriate consumer protection is still overestimated. Safe food and appropriate consumer protection can only be assured by holistic preventive measures applied throughout the entire food chain. The primary role of microbiological analyses is seen to be verification that the preventive and control measures are appropriate and achieving their set objectives, for example that the FSMS is ensuring food safety. To strengthen FSMS, *PathogenCombat* has developed diagnostic instruments and tools for SMEs to identify interventions which can improve FSMS. A concept of web-based FSMS support systems for SMEs has also been developed.

For further information, please visit the *PathogenCombat* homepage **www.pathogencombat.com**

You are also invited to register for the *PathogenCombat* '*NewsFlash*' available via the homepage.

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The story of Bt-brinjal in India: why it is not required

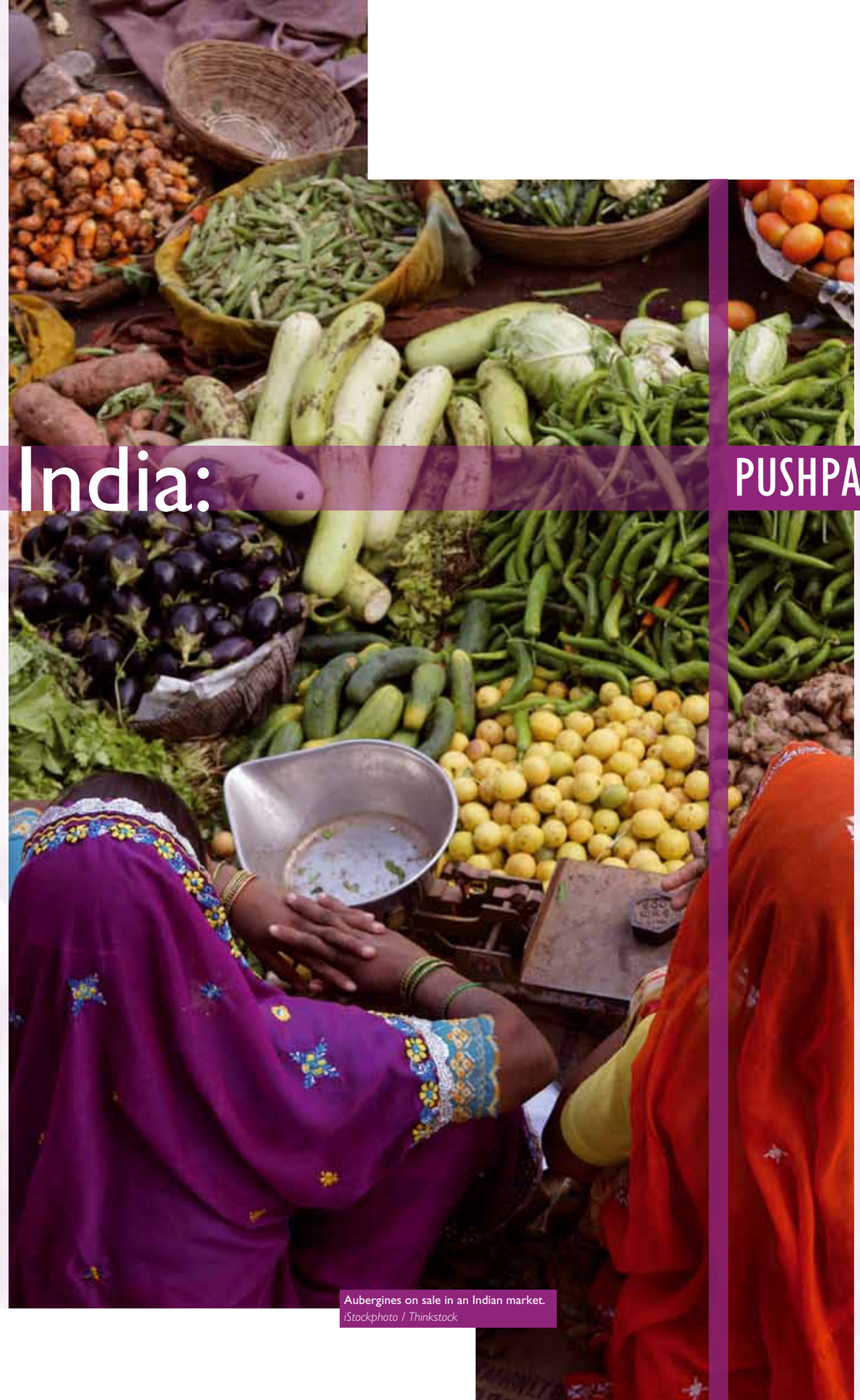
PUSHPA M. BHARGAVA

In late 2009, the Minister for Environment and Forests in India delayed the previously approved release of genetically modified aubergine plants (Bt-brinjal). Following a series of consultations, the Minister took the decision in February 2010 to place an indefinite ban on the proposed release.

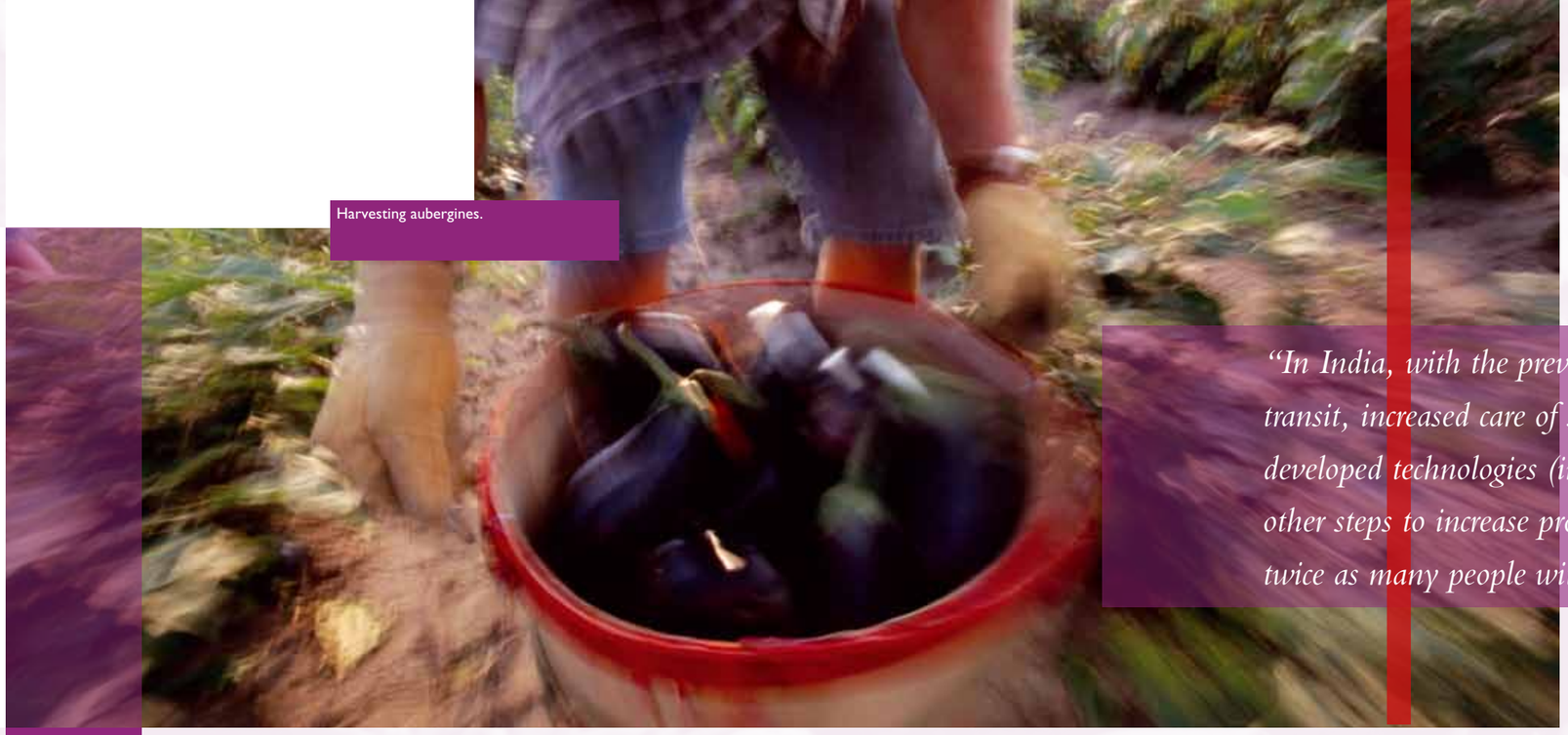
ON 14 OCTOBER 2009, the Genetic Engineering Approval Committee (GEAC) of the Ministry of Environment and Forests in India, approved the open release of genetically modified Bt-brinjal (aubergine) plants containing a bacterial gene that produces the *Bacillus thuringiensis* (Bt) toxin, toxic to certain pests, in spite of extensive criticism of the biosafety data that had been provided by the developers, Monsanto. The manner in which the entire process of approval by the GEAC had proceeded also cast serious doubts on the validity of the decision. This immediately gave rise to enormous protests from the media and the public all over the country, as well as many responsible and established scientists from outside India.

Mr Jairam Ramesh, Minister for Environment and Forests, took note of the above widespread and well-argued opposition to Bt-brinjal and, within 48 hours, decided to delay the decision for open release. He stated that he would allow time for consultation until 31 December 2009 for scientists and society across the world to comment on the biosafety data regarding Bt-brinjal and on the basis by which the GEAC had granted approval to Bt-brinjal.

In light of the comments received by Mr Ramesh and a further seven national consultations in January and February 2010 across India, accounting for the views of over 6,000 farmers, scientists, civilians, government officials and non-governmental organizations, Ramesh, placed an indefinite moratorium on the release of genetically modified Bt-brinjal on 9 February 2010. In doing this, he also made a far more important, though implicit, statement that India is not tied to any multinational corporation or any country. Mr Ramesh's statement, with appendices of over 600 pages, was well-argued and has few parallels in the history of modern India from the point of view of clarity, transparency, objectivity, fairness and public interest.



Aubergines on sale in an Indian market.
iStockphoto / Thinkstock



Harvesting aubergines.

"In India, with the prevention of food loss during storage and transit, increased care of soil fertility, the use of indigenously developed technologies (including organic agriculture), and other steps to increase productivity, there is capacity to feed twice as many people without using GM technology."

Sliced aubergine. *Goodshoot / Thinkstock*

"All international covenants clearly state that if a country is the centre of origin for a particular crop, that crop shall not be genetically engineered in that country."

Below, I summarize the findings of Mr Ramesh's report regarding the release of Bt-brinjal in India.

1 Apparently, India does not need Bt-brinjal. India already produces enough aubergines – the second most widely consumed vegetable in the country after potato. It is also the cheapest.

2 The damage by pests to aubergine crops in the country is marginal and there are several alternatives for crop management – such as integrated pest management, use of biopesticides and organic agriculture. In the State of Andhra Pradesh alone, there are 2 million acres under organic agricultural cultivation. This area will most probably increase to 10 million acres in the next few years, as a part of the State Government's policy. The yields of organically produced aubergine or cotton [Bt-cotton, being the only genetically modified organism (GMO) released so far in the country for commercial purposes] are comparable to the yields obtained using Bt-plants.

3 Over the years, there has been an exponentially growing number of reports on effects of GMOs. Over 60 such effects have been documented, including the creation of new allergens, reproductive interference, cancer, effects on growth, changes to soil ecology, animal health, gene transfer to normal gastrointestinal bacteria, appearance of GM DNA in recipients, killing of beneficial insects and development of resistance. On 6 March 2010 it was stated in the newspaper *The Hindu* that Bt-cotton was deemed ineffective by its marketer, Monsanto, on account of the development of resistance in the pests in parts of Gujarat, one of the major cotton-growing States in India.

4 Up to 30 tests should be carried out to ensure long-term biosafety of a GM crop; these include long-term consumer and environmental toxicity testing and proteomic analysis. However, in the case of Bt-brinjal, the dataset does not include a complete analysis using these tests.

5 India is responsible for the origin of aubergine cultivation, with more than 2,500 varieties, one of which has even been registered under the Geographical Indication clause of the Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS), ensuring authenticity of this variety. All international covenants clearly state that if a country is the centre of origin for a particular crop, that crop shall not be genetically engineered in that country.

6 The genetic construct that was used to create Bt-brinjal has never been fully justified. For example, why use a streptomycin resistance gene as a marker?

7 According to Monsanto's data, aubergine pollen can travel for up to 30 metres. In India, 84% of farmers (who account for 62% of the Indian population) are smallholders with less than 4 hectares of land. Aubergines are grown almost exclusively by these farmers, mostly in plots measuring less than an acre. To leave 30 metres around the plot to prevent contamination of a field by Bt-brinjal from an adjoining plot, would leave virtually no space for cultivation!

8 India currently has no liability laws to protect the interest of organic farmers whose farm may get contaminated by GM crops from a neighbouring farm.

9 The Indian population has a right to know what they are eating; however, there is currently no mandatory labelling of GM crops in the country.

10 India grows more than 150 different types of vegetable, each having specific and useful pharmacological properties. In addition, the country has a very substantial export market for its vegetables. The value of this market has been estimated to be Rs. 1,000 billion (about US$22 billion). This future market will be threatened once GM vegetables are grown in the country, of which there are already more than a dozen in the pipeline.

11 Raw aubergine is often fed to animals in the country and sometimes eaten half-cooked. There is some evidence that plants containing Bt-toxin can be toxic to animals that forage on them. Certain indigenous medicinal formulations used widely in the Ayurvedic and Unani systems of medicines also use raw aubergine. It is possible that Bt-brinjal may not be equivalent to non-Bt aubergine in such medicinal formulations, especially as aubergines contain toxic alkaloids which are destroyed only on cooking. This is why, in many cultures, aubergines are not given to very young children.

12 Over 90% of UN member countries have strict labelling laws and/or do not permit GM crops for human consumption. Some 85% of GM crops around the world are grown in just four countries, the largest proportion being in the US.

13 It has been often argued that GM food is the only way to meet the food requirements in the future. In India, with the prevention of food loss during storage and transit, increased care of soil fertility, the use of indigenously developed technologies (including organic agriculture) and other steps to increase productivity, there is capacity to feed twice as many people without using GM technology.

One may ask why the Government of India has been so keen to propagate GM crops in spite of what was found in the Ramesh report. Mr Ramesh has gone on record to say that he has only two supporters in the Government and the ruling party: Dr Manmohan Singh (Prime Minister) and Mrs Sonia Gandhi (Chairman of the ruling coalition). Therefore, it is likely that the issues surrounding GM food policy and release is not driven purely by scientific and social merit, but rather by political and financial incentives.

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It's holiday time again, but as you get ready to jet off for a well-earned break, don't let a few micro-organisms ruin your holiday!

boil it, peel it, cook it, wash it or forget it!

Travellers' diarrhoea has been defined as 'three or more loose stools in 24 hours with or without at least one symptom of cramps, nausea, fever or vomiting' (Hill & Ryan 2008)

TRAVELLERS' DIARRHOEA (TD) is the most common illness that affects international travellers. Each year 20–60% of globetrotters, an estimated 10 million people, develop TD. It can be caused by a variety of pathogens – viruses, bacteria and protozoa. These are transmitted by the consumption of contaminated food, water or both. The symptoms usually occur within one week of arriving in a foreign country; however, on occasions they may not develop until sometime later when the traveller has arrived back home. Symptoms are very unpleasant; they include vomiting, diarrhoea, abdominal pain and fever. Although the symptoms are usually self-limiting, clearing up in a couple of days, TD can often wreck a holiday. This article looks at some of the microbes that cause TD and explores how it can be both prevented and controlled.

MICROBES THAT CAUSE TD

The majority of all cases of TD (80%) are caused by bacteria, and approximately 40% are due to infections with enterotoxin-forming *Escherichia coli* (ETEC) bacteria. It usually causes mild, self-limiting diarrhoea which lasts for less than 72 hours. Other bacteria that can cause TD are *Campylobacter*, *Shigella* and *Salmonella*. These pathogens often cause bloody diarrhoea known as dysentery.

Bacteria can cause TD in two ways.

- Intact microbial cells infect and attack the cells lining the intestines causing inflammation; this makes it difficult for the body to absorb water and nutrients, leading to diarrhoea
- Some bacteria produce toxins which bind to the cells lining the wall of the intestines, leading to inflammation and diarrhoea.

Viral infections caused by rotaviruses and noroviruses, for example, have only been found in a small proportion of adult cases, but this may be due to lack of investigation. In children they are thought to account for a much higher number of cases (around 70%) of TD.

Protozoan parasites such as *Giardia lamblia* and *Cryptosporidium* frequently cause persisting diarrhoea, i.e. diarrhoea that lasts for more than 14 days.

HOW IS TD TRANSMITTED?

TD is usually transmitted via the faecal–oral route, by ingestion of faecally contaminated food and/or water.

This can occur through:

- water contaminated with faeces not being adequately treated before drinking
- poor hand hygiene after coming into contact with faecal material
- poor kitchen hygiene
- poor or inadequate sanitation

Where food is prepared is thought to affect the risk of contracting TD, for example food prepared in a private home is less risky than food prepared by street vendors.

The area that a person is visiting also affects the likelihood of developing TD. The illness is most common in warm countries where standards of sanitation and hygiene are poor. These are usually countries in the developing world, such as parts of Asia and Africa. Around 30–50% of people travelling from a developed country to a developing country will experience an incident of TD.

However, TD is not confined only to developing countries. People visiting low-risk countries, such as the USA or those in Western Europe, can still experience TD.

TIPS ON HOW TO PREVENT IT

Food

- Do not eat any uncooked or undercooked food
- Only eat fruit, vegetables or salads that have been peeled or cooked (even if they have been washed they could have been washed with contaminated water)
- Do not eat food sold by street vendors
- Do not eat/drink unpasteurized milk and dairy products

Water

- Do not drink tap water and do not use it to brush your teeth
- Only drink bottled water
- If bottled water is unavailable, then boil tap water to kill off unwanted pathogens – boil water vigorously for 1 minute and allow it to cool to room temperature
- Do not drink bottled water if the seal on the bottle has been broken
- Do not use ice unless you're sure it's made from purified water

Hand hygiene

Be honest – do you always wash your hands immediately prior to eating or preparing food? We all have hundreds of species of bacteria living in our guts and we can develop immunity to bacteria we are frequently exposed to. But your immune system may have never encountered some of the microbes you might meet abroad, so you have to be extra careful. Be scrupulous with hand hygiene: wash your hands thoroughly after visiting the toilet and before eating or preparing food.

TREATMENT OF TD

Most cases of TD are self-limiting, clear up within a few days, and do not require any drug treatment. The following advice may be followed to reduce the symptoms.

- It is essential to drink plenty of fluids to prevent dehydration; oral rehydration powder can be taken if you have lost a lot of water through vomiting or diarrhoea (don't forget to dissolve it in bottled or boiled water)
- Over-the-counter diarrhoea medicines may help; for example, loperamide slows down the action of the bowel and is very effective in treating diarrhoea – you can buy it in a pharmacy without a prescription, but always follow the instructions in the packet
- When diarrhoea persists, antibiotics may help to reduce symptoms if it is caused by a bacterium

DARIEL BURDASS is Head of Education, Outreach and Professional Affairs at SGM (email d.burdass@sgm.ac.uk)

FURTHER READING

Hill, D.R. & Ryan, E.T. (2008). Management of travellers' diarrhoea. *B Med J* 337, a1746. doi:10.1136/bmj.a1746

You must see a doctor if there is blood in your stools, you have a severe fever or if the diarrhoea doesn't get better in a couple of days as you could have contracted a serious illness such as cholera, typhoid or dysentery.

The why, when & how of hand washing

THE LATEST RESOURCE from the SGM is a 4-page fact file *The why, when & how of hand washing*. The brightly coloured leaflet explains how good hand hygiene can reduce the spread of infection and also help prevent food poisoning. Specially designed, bold cartoons are used to illustrate the key points. Inside the leaflet is an A3 pull-out poster demonstrating how to effectively wash your hands and on the back is a list of 'fascinating facts' about microbial transmission.

Key stage 5 resource is a great success

MICROBIOLOGY: A RESOURCE FOR KEY STAGE 5 has now been distributed to all school members, and as soon as it landed on laboratory benches the feedback from teachers and technicians was fantastic. It has also been used successfully as a marketing tool to attract new members, and school membership now stands at over 670, a record for this point in the year.

The pack is also a great resource for SGM members that do outreach work with 6th-formers as it contains up to date microbiology information relevant to the AS and A2 specifications, including contemporary topics such as hospital-acquired infections, biotechnology and the role of microbes in climate change. It reflects *How Science Works* and has relevance to the wider curriculum, including ethical and moral issues and the implications of science in society. A CD-ROM accompanies this resource, which provides comprehensive, full-colour PowerPoint presentations and a range of student activities. So if your are an SGM member involved in outreach and would like a free copy to support your activities, email education@sgm.ac.uk

Don't forget we have a comprehensive range of resources which can be used across the various key stages. These can be viewed at www.microbiologyonline.org.uk/teachers/resources

2010 Annual Schools Science Conference: Science is All Around Us

Over the last 10 years there has been a significant downward trend in the number of pupils opting to study science in 6th form and at university. This is an alarming trend for the future of science and there are many factors involved; one key factor is a lack of understanding and knowledge of the career options that are available in science. In an effort to address this decline, the British Science Association organizes National Science and Engineering Week with a programme of events and activities for pupils of all ages. One event that specifically targets pupils between the ages of 13 and 19 is the Annual Schools Science Conference. The 7th conference was held in March 2010 at the Royal College of Pathologists, London.


John Goodman on behalf of Science4u (www.science4uinfo) and the Royal College of Pathologists

The overall theme of the day was 'Science is All Around Us'. There were formal lecture-style presentations as well as informal, interactive stands on a variety of different subjects. These stands were manned by scientists and healthcare professionals from a wide range of backgrounds, including representatives of the London ambulance service, histopathologists and cardiac anaesthetists. In addition, there were a number of microbiology stands educating the students on the role of microbiology in the diagnosis and management of infection. These included stands displaying (silicon) plates of different bacteria and information regarding the importance of hand washing in the battle against hospital-acquired infections.

OUR MICROBIOLOGY STAND

Our stand drew much attention from both children and teachers. We had a display of parasites, including liver flukes, pinworms and tapeworms, together with information about the respective diseases they cause. The specimens drew many shrieks of '*Eww!*' when, for example, they were asked if they wanted to hold the tapeworm!

Along with the hands-on display, we had a microbiology quiz about 'good bugs and bad bugs' provided with answers and a factsheet about the featured organisms. While several pupils filled it in, it was a major success with teachers, many of whom asked if they could use it as a classroom exercise.

The backdrop of our stand was a poster display on sexually transmitted infections (STIs) – an important and especially relevant topic given the age range of the pupils at the conference. We talked to children and teachers about chlamydia, HIV, gonorrhoea and genital herpes, discussing the science behind the diagnosis and treatment of STIs, and answering any questions they had.

Without a doubt the largest role we played was in our capacity as healthcare professionals in providing the students with potential career advice. There was a wide mixture of questions from '*what do you do?*' to '*what A-levels did you need?*' and naturally '*do you really work with bacteria?*' Interestingly, most of the older pupils had stories of their own and wanted tailored advice to suit their own career needs.

FEEDBACK

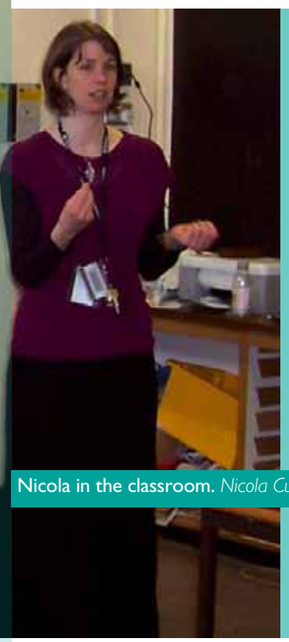
Many of the children had never heard of parasites or microbiology beforehand and appeared to take a genuine interest in our stand. Feedback from the conference website has been very positive. One teacher wrote: '*I just wanted to say a great big thank you, as we had a fantastic day yesterday.*' Feedback from the schoolchildren was also good, with one student remarking: '*I was so glad I was able to make it, as it really was amazing. A big thank you to you and everyone involved and I can't wait until next year.*'

SUMMARY

The conference was a fun and well-organized event that allowed both teachers and students from all backgrounds to interact with professionals in the healthcare and science industries. It remains to be seen whether this kind of exposure leads to an increased intake to science-based degrees, especially from students who traditionally would not have considered even going to university. The conference allowed students to gain free advice and information about all aspects of science for their future careers and as such it was a more than worthwhile venture.

SHORMILA ROUTLEDGE & VANESSA WONG, Queen's Medical Centre, Nottingham (email vanessawong@doctors.org.uk)

Researchers in Residence (RinR), funded by Research Councils UK with support from the Wellcome Trust, is a programme enabling researchers to spend time in a school working with young people. The researchers offer an 'added extra' to host schools, giving students an opportunity to experience real-life research and be inspired. Importantly, researchers build on their skill-set by preparing and presenting work to a different audience. RinR is open to all PhD and postdoctoral researchers funded directly or indirectly by one of the seven UK Research Councils or the Wellcome Trust. SGM member Nicola Cumley tells Jane Westwell about her experiences as a researcher in residence.



Nicola in the classroom. *Nicola Cumley*

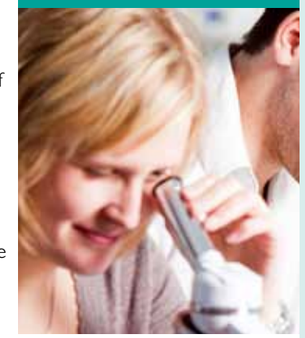
Researchers in Residence

After signing up to RinR, I attended a day of training where we learned about the scheme. A researcher who had previously completed a placement shared their experience. We had a go at activities aimed at making us think how to explain our research to a non-specialist. We were also given tips on how to prepare for going into school. Training completed, I was paired up with a school and host teacher, and it was over to me.

PREPARATION, PREPARATION, PREPARATION

The teachers at my allocated school were incredibly helpful and dedicated. Although I had decided to be flexible and let them lead in deciding what I should cover, they sent me the microbiology section of the GCSE syllabus with the instruction that I could cover what I wanted! This was slightly daunting. I had hoped to talk about infectious diseases, but their chosen syllabus focuses on industrial applications of microbes.

All this happened in the space of 3 weeks: from meeting the teacher to standing in front of a class. I set about making some ambitious lesson plans based around every part of the syllabus. Luckily, I decided to revisit the school, discuss my plans with the teacher and observe a lesson. The teacher gave me helpful tips on preparing handouts, splitting the lesson up into activities and how much to prepare for each lesson – she told me that what I had prepared was too complicated and lengthy! I met the technicians who were fantastic; they helped me to organize my practicals, with advice on what would work and what equipment they had. It did get a bit stressful: I didn't know how to pitch the lessons or how much could be covered, and I was keen that the students should learn something relevant to their course, whilst having a bit of fun. The most nerve-wracking thing was that I had 6 lessons with the same class. If it all went wrong on day one, I was going to have a miserable 5 hours over the next few weeks…



THE PLACEMENT

I started each class with a quiz, which the students liked! The questions were a mixture of what we had discussed previously and some which were just a bit silly (from a *Horrible Science* book).

My first session was 'What are microbes?' I had set up stations around the classroom with different microbiological items, and the students had to have a look, read the information, then answer the questions. Items included slides with the malaria parasite and mosquito, bacteria on blood agar plates, mushrooms and, the star of the show, a tapeworm in a jar. I also described the different classes of microbes and, with the aid of Maltesers (viruses), fluffy *E. coli* (bacteria), a balloon (fungus) and a 100 m running track, explained microbial size. The students were fantastic, they all got involved and asked questions. Already my opinion of teenagers was changing – they were very real and very smart people. I covered about a third of what I had prepared, but it worked!

Before the next lesson, they all looked at me expectantly as I arrived. I think they were hoping I was going to continue talking about poo and passing tapeworms, but now we were moving on to more serious science. Session two was 'Microbes are everywhere'. We covered aseptic technique and swabbing benches. In this session I had to demonstrate practical methods – something I had not really thought through. So I was at the front, not able to work the Bunsen burner, in oversized gloves, an apron and safety goggles so scratched I couldn't see a thing! I also realized not everyone understood the scientific terms I was using such as 'broth' and 'agar'.

The third lesson was the most 'experimental', demonstrating what microbes need to grow. I had brought some broth cultures

iStockphoto / Thinkstock

that the students incubated under different conditions. I loved it, but I think they found it a bit too complicated. Maybe one day they might remember doing something with bacteria and them needing amino acids to grow!

The next session focused on how bacteria grow. I took some spectrophotometer readings and got the students to plot a graph. Then we discussed how a population grows. Although I didn't think this would be an exciting session, the students seemed to like it and it sparked some interesting discussion about natural selection and microbes' role in the food chain.

Back to the syllabus for lesson 5, and we talked about different uses of microbes in industry. I had asked them to find uses before the lesson and then list them. The practical element to this was watching how yeast could make bread rise at different temperatures.

The last session on swine flu was a bit more topical. Several schools in the area had recently been closed and there had been a few cases at this school. I showed them the latest HPA and WHO figures and tried to put the disease into context away from the media hype. I then asked them to make a

poster answering one FAQ on flu, including '*What is a pandemic?*' and '*Why do you think the West Midlands has more cases of swine flu than elsewhere in the country?*' This activity bought out some excellent posters and answers. Once again, I was impressed with their intelligence, enthusiasm and the interest they expressed.

WHAT DID I GAIN FROM THE EXPERIENCE?

The whole experience was really uplifting, but incredibly hard work. I had prepared at least three times more material than could be covered, and trying to organize the equipment needed for each session was really difficult.

It was scary standing up in front of a class knowing you have to keep their attention for the next hour. In the second lesson, the overhead projector was broken so I couldn't use my carefully prepared Powerpoint presentation. Once I had got over the initial panic, I learned it was better to use the board instead, and use Powerpoint for images. This took less preparation time and was less distracting for the students.

I gained a huge respect for teachers. The experience gave me an insight into what a hard and amazing job they do. I was fortunate to work with some great people who inspired me. I also developed a huge respect for teenagers – everyone should go and visit a school to realize that they are not at all like they are reported in the press.

WHAT THE SCHOOL GAINED

It is hard for me to say what the school gained. I think the pupils enjoyed the chance to see different aspects of microbiology and meet someone who is not a teacher. I hope that it might have sparked at least one of them into studying biology further. A similar meeting with a microbiologist encouraged me when I was at school.

WHAT NEXT?

I have now signed up to be a STEM ambassador, a national scheme to encourage people working in science to get involved with schools. I would really recommend the researchers in residence experience to anyone who likes talking about science!

NICOLA CUMLEY, University of Birmingham
(email nja825@bham.ac.uk)

FURTHER INFORMATION

www.microbiologyonline.org.uk – SGM education website
www.sgm.ac.uk – 'Microbiology in the News' and 'Micro Encyclopedia' from the SGM website
www.researchersinresidence.ac.uk/cms/ – researchers in residence website
www.hpa.org.uk
www.fungi4schools.org
www.cellsalive.com

Filming the 'ranchers' in Colorado. *Gemma Walton*

Dr Gemma Walton from the Department of Food & Nutritional Sciences, University of Reading, is the recipient of the 2010 SGM Outreach Prize. Here she summarizes some of her recent activities. Gemma will deliver her Prize Lecture at the SGM autumn meeting in Nottingham (see enclosed booklet for details).

More than a gut feeling…

Gemma on set. *Gideon Bradshaw*

I have always enjoyed outreach activities with school groups visiting the lab – seeing the '*urgh*' moment when a class realize that to study the bacteria within the gut we have to use faeces! But more than this, it is when members of the group become interested and enjoy the activities.

In 2007, I helped to organize the department's display stand at the Royal Society *Summer Science Exhibition* – it was a great opportunity to convey our research and the world of microbes to a wide range of visitors, making for a really enjoyable week.

Thanks to Professor Glenn Gibson, I have been involved with several media activities, including the cowboy-themed (*Blazing Saddles* style) episode of the BBC's *The Truth About Food*. It was an unmissable chance to convey the concepts of prebiotics and probiotics to a wide audience, in a humorous way, in the beautiful setting of Colorado. Of course, it was not all glamour – I was studying the faeces of cowboys on different diets! The ranchers, the film crew and the presenter, Fiona Bruce, were all really friendly, making it a great experience.

Following this, the CBBC programme *Gastronuts* was making an episode on flatulence. I was quizzed by children and the presenter, Stephan Gates, on the what, why and how of flatulence – while they tried to eat the most flatulence-inducing diet – making for an amusing look at microbiology.

For me the great thing about the area of gut microbiology for science communication is that everyone can relate to it!

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'New media' is a term that is often bandied about, but its definition is unclear. It is often used to refer to internet applications that aren't static websites, such as social networks, podcasts, videos and blogs.

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SGM AND NEW MEDIA

New media is different from traditional, or 'old' media (including newspapers, television and radio) in that it allows its users to interact with content, post content themselves as well as connecting with other users to form communities around that content. New media is also immediate, allowing users to receive information instantaneously, at the touch of a button. Users can specify the content they want to receive, and when and how they want to receive it.

Social networks, podcasts and blogging are now a part of everyday life and are important (and sometimes exclusive) channels of communication for many. More and more organizations are exploiting these outlets to connect with their existing target audience and perhaps try and attract new audiences.

SOCIAL NETWORKS

Social networks such as *Facebook*, *Twitter*, *Bebo* and *MySpace* are often the first examples of new media that spring to mind and are often in the spotlight. *Facebook* was launched in 2004 and with over 400 million users is the most popular social network. Individuals on *Facebook* set up personal profiles, through which their *Facebook* 'friends' can interact, posting messages to their 'walls', uploading photos and sharing links to videos or websites. Organizations using *Facebook* can set up a similar profile, known as a 'page', to interact with people who 'like' their page.

I set up the SGM *Facebook* page in November 2009, very unsure of how successful it would be. I started posting links to microbiology stories in the news and posting details of upcoming scientific meetings and educational outreach events. During events, such as our recent spring meeting in Edinburgh, I was able to upload photographs each day and effectively document the meeting as it happened. I also often upload photographs of staff, and birthday or retirement celebrations that take place at Marlborough House so people get an idea of the professional team behind the Society. The people connected to the page regularly comment on photographs that are posted and conversations around news links often manifest themselves.

Anyone linked to the SGM page can post content to it – from advertisements for new PhD studentships to links to 'cool' soaps resembling bacterial cultures growing in Petri dishes! A number of SGM staff, both past and present, use the page regularly to keep up with what's happening in other departments. Staff can always be relied upon to provide a running commentary on photographs as part of their constant surveillance for any that may be incriminating!

The number of people linked to the SGM *Facebook* page has grown hugely since the page was launched. We started with a pool of about 50 people who were carried over from a previous SGM *Facebook* group. Since then, numbers have been steadily increasing and stand at just under 800 at the time of writing. We have people all over the world connected to our page with most users based in UK, US, Costa Rica, Malaysia, Ireland, Nigeria and Egypt.

The SGM *Facebook* page is also linked to the SGM *Twitter* account where we provide our followers with short updates. *Twitter*, launched in 2007, is a network based on real-time 'micro-blogging' that allows people to interact via blogs of a maximum of 140 characters. Twitterers can reply to each other's 'tweets' creating a multi-person dialogue. Around 50 million tweets are sent per day by a wide range of users, including celebrities, politicians and high-profile business executives.

Tweets can be sent very easily from a mobile phone via a text message, which is a useful way of sending short updates when we are out of the office at events. At the *Big Bang* fair in Manchester

this year, SGM followers on *Twitter* would have heard exactly how many school children came through the doors in just 3 days (almost 20,000), how much they enjoyed the cross-contamination activity involving plastic food and glow gel, and even how Peter Andre was spotted in our hotel one evening – much to our excitement!

As *Facebook* and *Twitter* are an integral part of so many people's lives, it seems a great way to update people who may not be on a mailing list or who do not check our website regularly, or who may never even have heard of the Society. Importantly, these networks allow people to provide us with informal feedback on our activities and give us ideas for new ones.

PODCASTS

Podcasts are audio or video files that can be automatically downloaded from the internet to your computer or portable media player. Podcasts deliver content to the user who perhaps does not have time to read magazines or even browse websites, but will enjoy listening to a 10-minute podcast on their way to work.

As I learnt on a recent training course on producing podcasts, there are no set rules. Anyone can make podcasts, about any subject. Content can be delivered in different ways, from news items to interviews to debates. Podcasts can be aimed at school children, parents or scientists, among others, and can last anywhere from a couple of minutes to an hour.

Podcasts really lend themselves to science as the success of the *Naked Scientists*' podcast shows. Hearing someone explain scientific concepts rather than reading them often makes information easier to digest and offers a great opportunity to hear from the people behind the research. Hearing a scientist speak about their work (particularly if they are enthusiastic!) makes it real, accessible, understandable and relevant.

I first dabbled in podcasting this year at the SGM spring meeting. I thought I was all ready to go: I had managed to convince a couple of enthusiastic speakers that they wanted to do a 20 minute interview with me, successfully untangled all the microphone cables and had finally got the sound settings right. Actually, recording the interviews was harder than I expected.

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My first recording was with Professor David Russell from Cornell University, New York, who was talking about his research on TB and how dysregulation of host lipid metabolism was an important factor for progression of disease. There was a lot of complex molecular biology to explain, and one thing I became aware of very quickly during the recording was that the interview had to be tailored to an audience who were not physically present to raise their hand if they didn't understand something. David was brimming with enthusiasm and was excellent at explaining the rationale behind his research, which was fantastic. However, I was conscious of interjecting to ask him to clarify certain terms such as 'lymphocytes' and 'macrophages' that he was obviously used to using all the time, but that would need to be defined for podcast listeners. In addition to monitoring the level of language, I was continually making sure both David and I were speaking clearly and at the right angle into the microphone, while trying to listen carefully to make sure I sought all the information the listener would want. It's not as easy as I first thought, but the interviews will certainly make for interesting listening (after some editing!)

The recordings from this meeting are currently being edited and will appear on the SGM main website, and on the SGM education website microbiologyonline, in the near future.

WHAT'S NEXT?

New media is just that – new, and it's very difficult to know what will explode onto the scene next. While people will still enjoy flicking through a magazine or watching a science programme on TV, organizations including the SGM will need to keep on top of what's popular, to ensure they put themselves where their public is (and their scientists are).

Old and new media are not mutually exclusive, and quality content forms the basis of them both. In this way, a radio broadcast can form the basis of a podcast, a magazine article can be linked to on *Facebook* and newspaper headlines can be tweeted. Both old and new media will help the SGM to carry out its mission of promoting modern microbial science and connect to the next generation of microbiologists.

New media is not foolproof and is a constant learning curve, as I am discovering. Different tools work for different things and at different times, and you can often only discover this by getting stuck in and trying it out. One advantage is that these technologies have an intrinsic feedback mechanism which allows you to work out pretty quickly whether they are being well received or not!

LAURA UDAKIS is Press and Public Affairs Manager at SGM (email l.udakis@sgm.ac.uk)

The Millennium Centre, Cardiff. *Laura Udakis*

Science and the Welsh Assembly

On Tuesday 18 May 2010, the Royal Society of Chemistry held its annual Science and the Assembly event in Cardiff, split between the iconic Wales Millennium Centre and the stylish Welsh oak and slate Senedd.

This event aims to bring together the scientific community in Wales, the Welsh Assembly Government and Assembly Members to discuss topical science issues. The event opened with a keynote speech from the newly appointed first-ever Chief Scientific Officer for Wales, Professor John Harries, on Scientific Policy and Advice in Wales. High-profile researchers from around Wales then delivered scientific presentations on the theme of this year's event Science, Innovation and Enterprise. Afterwards, a buffet and exhibition in the Senedd, specifically timed to follow the Assembly's plenary session that afternoon, allowed the delegates to mingle and chat, as well as explore the displays.

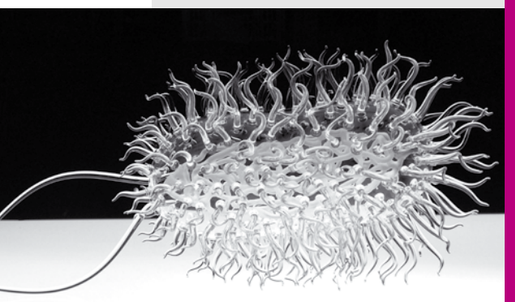
The SGM participated in the exhibition. Our educational resources, briefing papers and copies of *Microbiology Today* were all well-received. As one Welsh Assembly member commented, '*It was extremely pleasing to have scientific information presented in such a clear and well-illustrated manner.*'

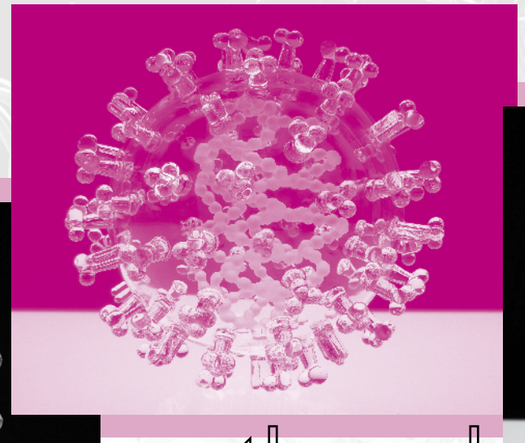
The event concluded with an address from Lesley Griffiths AM, Deputy Minister for Science, Innovation and Skills.

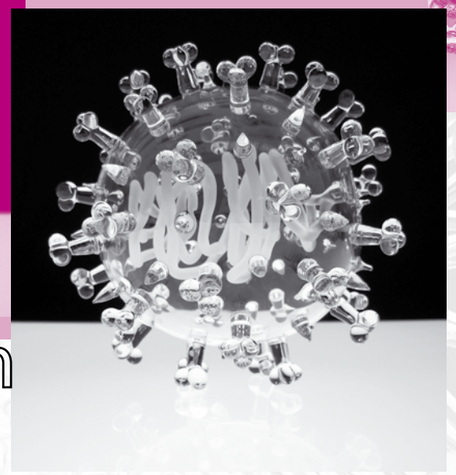
DARIEL BURDASS is Head of Education, Outreach and Professional Affairs at SGM (email d.burdass@sgm.ac.uk)

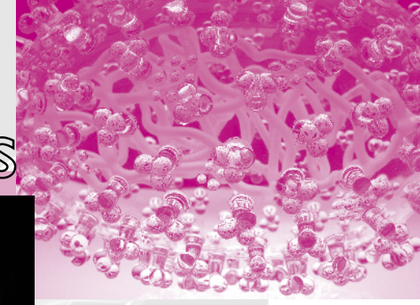
Laura Udakis manning the SGM stand. *Dariel Burdass*

Seeing right through microbes









From left to right: ***Escherichia coli*****, smallpox virus, HIV, swine flu virus (series 2), SARS virus and detail of the swine flu virus (series 1).** *Luke Jerram – www.lukejerram.com*

Luke Jerram is a multidisciplinary artist based in Bristol, UK, producing inspiring and highly acclaimed sculptures, installations and live arts projects. He has a fascination with how the world works and often collaborates with scientists and engineers in the preparation of his projects. His work, challenging as it does the conventions of perception, is fuelled by the fact that he is colour-blind.

One of Luke's most renowned projects of recent years is a series of transparent, three-dimensional sculptures of bacteria and viruses rendered in glass, for which he won an Institute for Medical Imaging Award.

Luke says, '*These transparent glass sculptures were created to contemplate the global impact of each disease and to consider how the artificial colouring of scientific imagery affects our understanding of phenomena. The question of pseudocolouring in biomedicine and its use for science communicative purposes, is a vast and complex subject.*'

'*If some images are coloured for scientific purposes, and others altered simply for aesthetic reasons, how can a viewer tell the difference? How many people believe viruses are brightly coloured? Are there any colour conventions and what kind of 'presence' do pseudocoloured images have that 'naturally' coloured specimens don't? How does the choice of different colours affect their reception?*'

The sculptures were designed in consultation with Andrew Davidson, a virologist from the University of Bristol, using a combination of scientific photographs and models. They were made in collaboration with glassblowers Kim George, Brian Jones and Norman Veitch. They include representations of *Escherichia coli*, and smallpox, HIV, avian flu and H1N1 swine flu viruses (ironically, Luke was suffering from flu and taking Tamiflu whilst he was working on the swine flu model).

Only five copies of each model were produced and they are now in a number of private collections around the globe and on permanent display at the Wellcome Collection, London and in Bristol City Museum.

His latest project is called *Aeolus* – an acoustic wind pavillion – designed for the public to contemplate the UK landscape; to make audible the silent shifting patterns of the wind and to visually amplify the ever-changing sky.

Come dine with microbes…

Kim Hardie at Nottingham has been cooking up some interesting dishes. Like chefs, microbiologists follow recipes. Like culinary masterpieces, many aspects of microbiology are aesthetically pleasing. Could cooking be used to inspire discussion about principles of microbiology? And so was born a quest for food that resembles microbiology-related subject matter. Kim said, '*Ultimately the aim is to collect enough recipes for a book that fuses insight into microbiology with some rather nice meals! This could generate an alternative tool to aid learning through cooking and eating in an imaginative way, sparking an interest and motivation to deliver the next generation of microbiologists.*'

We are familiar with the links between microbiology and food – the good stuff, like fermented foods, bread and wine, the bad stuff like* Salmonella*, and the ugly spoilers. But what other links can we make using our ubiquitous friends?

To start at the very beginning, and illustrate first principles, Kim has created two edible versions of a bacterial culture plate: a simple red-jam tart with white chocolate buttons placed on top to mimic a blood agar plate for counting colony-forming units, and a lemon curd tart with white chocolate buttons added while it was still warm to mirror a nutrient agar subculture plate and enable a discussion about how dilution to single colonies is achieved with each streak.

Meanwhile at Manchester Metropolitan University, it is the students who have been donning their aprons. Subsequent to the 'microbiology and art' lecture delivered by Jo Verran to her undergraduates, students are encouraged to be creative with their assignment, linking the two subjects. Culinary arts were new ideas for 2010, with one group of students (Siobhan Webb, Anthony Clayton and Mark Worrall) baking biscuits representing three food-poisoning bacteria, *Salmonella*, *Bacillus cereus* and *Staphylococcus aureus*. The skin biofilm cake (Jessica Murray) had coccal chocolate truffles (staphylococci) and rod-shaped peanut truffles (propionibacteria) atop a flesh-coloured butter icing. Plant and animal cells made of different coloured jellies, with various sweet implants (organelles and ribosomes, etc.) completed the trio of delicacies (Rima Saad and Sobia Sheikh). The products were devoured (part of the assessment of course!), and recipes will be combined with those that Kim is working on to produce a different slant on cooking with microbes.

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Magnificent Microbes


Jon Urch

SGM Public Engagement with Microbiology Awards provide small grants to support projects that promote public understanding of the subject. In 2010, Nicola Stanley-Wall and Joanna Fyans from the University of Dundee was awarded a grant under this scheme to help her and her team develop a public event at 'Sensation', the Dundee science centre.

In October 2009, members from the Division of Molecular Microbiology at the University of Dundee attended a one-day workshop designed to enable us to create and run a public engagement event. The main objectives of the day were:

- to use fun and interesting activities to make children and adults aware of how fascinating microbes really are;
- to train PhD students, postdoctoral scientists, lecturers and professors in the art of communicating science to members of the general public; and
- to develop a bank of resources for future events.

We came away with an outline of the event that morphed into *Magnificent Microbes*, which was funded by several sources including the SGM, the British Society for Plant Pathology and the British Mycological Society. Months of effort by *Team Magnificent Microbes* culminated in a 2-day event that took place on Friday 21 and Saturday 22 May 2010 at the Dundee Science Centre – Sensation.

The team developed 10 activity stands encompassing:

- microbial diversity in the form of microscopy and Play-Doh modelling (with an impressive number of novel microbes being invented!)


Sarah Hussain

- glow-in-the-dark bacteria and a very messy game called *Blast a Biofilm* to highlight bacterial communication
- a hands-on activity discussing the origins of antibiotics, requiring lab coats and the isolation of microbes from soil
- the classic (and ever popular) agar hand print activity
- one which looked remarkably similar to a lava lamp with cyanobacteria trapped in algal beads
- an exploration of how microbes help in food preparation
- a rather noisy activity involving balloons to show why a cell wall is needed and how antibiotics work
- an activity designed to highlight how microbes can be used to understand how processes go wrong in eukaryotes
- a futuristic stand with hydrogen-powered cars where the hydrogen was generated from a fermenter containing *Escherichia coli*
- a stand with a squishy cucumber, biological washing powder and an enzyme assay developed by visitors to demonstrate how plants can be infected by microbes.

With all of the resources in place and the posters printed we were finally ready…

The first day of our event was for approximately 180 local primary school pupils from years 5, 6 and 7 from Ardler, Fintry, St Pius, Clepington, St Clements and Blackness Primary Schools. Thanks to the development day, held at Sensation in April 2010, the actual event ran very smoothly as all first night nerves had been successfully overcome. At this point, we would like to thank the children from Carnoustie Primary School who were our 'guinea pigs'!

The feedback we received from both teachers and children indicated that fun was had by all: '*cool*', '*yuck*' and '*wow*' were heard from many of the children (and adults) around the room! In particular, putting on lab coats and safety goggles seemed to be very popular.


Jon Urch

The following day was open to members of the public. We had to compete with the hottest day of the year, but despite this over 120 people attended, including family and adult-only groups. As with the school event, people who attended thoroughly enjoyed themselves and learnt a lot. We did however decide that *Magnificent Microbes 2*, planned for 2012, would be scheduled for late autumn or early spring to try to avoid such hot competition with the weather!

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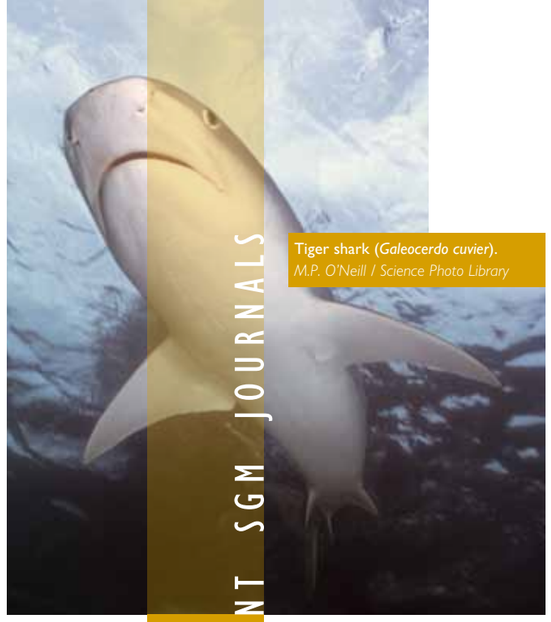
Sarah Hussain


Jon Urch


Jon Urch


Max Fritsch



Tiger shark (*Galeocerdo cuvier*).
M.P. O'Neill / Science Photo Library

Shark attack!

Movies set in tropical seas frequently include a dramatic shark attack, with *Jaws* the most celebrated example, but in real life, attacks are not as frequent as the movies suggest. Only 400 fatalities have been recorded since systematic records began in the early 1900s. However, many people who survive an attack suffer from serious infections in their wounds. Treatment includes large amounts of antibiotics as a precaution against the many types of bacteria that might be present in these deep bites. There is surprisingly little information on which bacteria are actually present or their antibiotic sensitivity.

Scientists in Recife, a coastal city in Brazil, have set out to remedy this lack of knowledge so that more targeted treatments can be developed. Recife has one of the highest annual number of shark attacks in the world. A total of 53 incidents were recorded between 1992 and 2009, resulting in 20 people bleeding to death. Two shark species, the bull shark (*Carcharhinus leucas*) and the tiger shark (*Galeocerdo cuvier*), cause most of the damage.

The researchers sourced their bacterial isolates from nine sharks taken from the sea near Recife. After swabbing the surface of the teeth and gums, the researchers used a wide range of culture methods to encourage any bacteria that were present to grow. They isolated individual bacterial colonies and identified 14 species frequently associated with tissue and blood infections. Some might have been long-term inhabitants of the shark's mouth while others could have been picked up from sewage discharged into the sea. However, it was clear from these results that shark bites were full of pathogenic bacteria. Tests of antibiotic sensitivity showed that two species of Gram-negative bacteria were likely to be resistant to several antibiotics. These were *Citrobacter freundii* and *Proteus mirabilis* and the latter is widely reported as a cause of opportunistic infections in wounds. Most strains of the other pathogenic bacterial species were sensitive to many antibiotics so that infections should be readily treatable.

In parallel, the researchers also examined treatment records from the local hospital of people who had survived shark attacks. These suggested that the extent of the wounds was the main factor determining whether bacterial infection occurred. Comparing the antibiotic treatment of the patients with the antibiotic sensitivity of the bacteria from the sharks showed that most were sensitive to the antibiotics used. However, the comparison also indicated that commencing treatment with a different broad-spectrum antibiotic might enhance effectiveness.

Interaminense, J.A., Nascimento, D.C.O., Ventura, R.F., Batista, J.E.C., Souza, M.M.C., Hazin, F.H.V., Pontes-Filho, N.T. & Lima-Filho, J.V. (2010). Recovery and screening for antibiotic susceptibility of potential bacterial pathogens from the oral cavity of shark species involved in attacks on humans in Recife, Brazil. *J Med Microbiol* 59, 941–947.

A juicy tale

Food microbiologists have a particular interest in bacteria that form spores because some of these species cause serious food poisoning. It is a particular problem because the spores are much more difficult to kill than normal bacterial cells, and thus food-processing methods need to be designed specifically to destroy them. However, amongst spore-forming bacteria is one unusual group, called *Sporolactobacillus*. This genus was discovered in 1963 with characteristics of both spore-forming *Bacillus* and lactic acid-producing *Lactobacillus* that are the benign bacteria of yoghurt, cheese, sausages and probiotic drinks. *Sporolactobacillus* bacteria are typically found in soil but sometimes appear in fermented or spoiled food. Their ability to grow in the absence of oxygen, produce lactic acid, grow well at around pH 5.0 and generate spores that can tolerate a temperature of 80°C for 5 minutes, is a unique combination of characteristics of the two groups.

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Researchers in the Laboratory of Quality Control R&D of the Japanese food company Mitsui Norin Co. Ltd were recently surveying the microbes that spoiled orange juice. They came across unusually heat-tolerant lactic acid bacteria that were the cause of the spoilage, and after running a series of tests, realized that they had found a novel species of *Sporolactobacillus*. As well as testing the conditions in which these new bacteria grew, the researchers also analysed the cell walls, cell lipids and DNA sequence of two genes frequently used to characterize bacteria. Although some of the results instantly matched with the current seven species of *Sporolactobacillus*, others differed enough to make it clear that this was in fact a novel, eighth species.

In naming the species, the researchers thought back to the origin of the bacteria, in spoiled orange juice with an organic, acid odour. As a consequence, they will be forever known as *Sporolactobacillus putidus*, from the Latin word for 'stinking'.

Fujita, R., Mochida, K., Kato, Y. & Goto, K. (2010). *Sporolactobacillus putidus* sp. nov., an endospore-forming lactic acid bacterium isolated from spoiled orange juice. *Int J Syst Evol Microbiol* 60, 1499–1503.

Detecting prions in blood

There continues to be a very practical problem with diagnosis of neurodegenerative spongiform encephalopathy diseases such as BSE and CJD. They have an incubation period of months to decades during which there are no symptoms, even though the pathway of converting the normal brain PrP protein into the toxic, disease-related PrP^{Sc} form has started. At present, there is virtually no way to detect PrP^{Sc} reliably except by examining the brain using neuropathological and immunohistochemical methods after death. Accumulation of the abnormally folded PrP^{Sc} form of the PrP protein is a characteristic of the disease, but it is present at very low levels in easily accessible body fluids like blood or urine. Researchers have tried to develop methods to measure PrP^{Sc}, but there are still no fully accepted methods for use in materials such as blood.

A team from New York has now described detection of PrP^{Sc} even when initially present at only one part in a hundred thousand million (10^{-11}) in brain tissue. The method combines amplification with a novel technology called SOFIA (surround optical fibre immunoassay) and some specific antibodies against PrP^{Sc}. After amplifying and then concentrating any PrP^{Sc}, the samples are labelled with a fluorescent dye using an antibody for specificity and then finally loaded into a micro-capillary tube. This tube is placed in a specially constructed apparatus so that it is totally surrounded by optical fibres to capture all light emitted once the dye is excited using a laser. The technique allowed detection of PrP^{Sc} after many fewer cycles of conversion than others have achieved, substantially reducing the possibility of artefacts, as well as speeding up the assay.

The researchers also tested their method on blood samples from apparently healthy sheep that went on to develop scrapie. The animals' brains were analysed once any symptoms became apparent. The researchers could therefore compare results from brain tissue and blood taken once the animals exhibited symptoms of the diseases, with blood obtained earlier in the animals' lives, and from uninfected animals. The results showed very clearly that PrP^{Sc} could be detected in the blood of animals long before the symptoms appeared.

After further development and testing, this method could be of great value in surveillance for the disease. Although the worst predictions about BSE have not been fulfilled, in particular the amount of transmission from cow to human to cause variant (v) CJD, the disease has not gone away. vCJD has been the definite or probable cause of death of 168 people in the UK in the two decades to 2010. The full incubation period is unknown but can clearly be decades, during which time no symptoms are evident. Unfortunately, it is possible for the disease to be transmitted between humans through organ and blood donations. A rapid method for testing these tissues for PrP^{Sc} would bring reassurance that this can be prevented.

Hemera / Thinkstock

Rubenstein, R., Chang, B., Gray, P., Piltch, M., Bulgin, M.S., Sorensen-Melson, S. & Miller, M.W. (2010). A novel method for preclinical detection of PrP^{Sc} in blood *J Gen Virol* 91, 1883–1892.

iStockphoto / Thinkstock

Don't spoil the wine

Nardi, T., Corich, V., Giacomini, A. & Blondin, B. (2010). A sulphite-inducible form of the sulphite efflux gene *SSU1* in a *Saccharomyces cerevisiae* wine yeast. *Microbiology* 156, 1686–1696.

There is a long tradition of adding sulfite to wine to improve its quality. During fermentation of grape juice into wine, the yeast cells naturally produce a small amount of sulfite. However, most winemakers add more, typically between 80 and 350 mg per litre, because sulfite is a good preservative: it inhibits the growth of bacteria and removes dissolved oxygen, both of which can spoil wine. A few people are very intolerant of sulfite, so most wine is labelled 'contains sulfites' as a reminder, as are other sulfite-containing foods, such as dried apricots where the antioxidant effect of sulfite allows them to retain their natural orange colour.

Grape juice can ferment to alcohol through the activities of wild yeasts on grape skins. However, most wines are produced by adding a carefully selected strain of the yeast *Saccharomyces cerevisiae* to the grape juice for a more reliable and palatable product. Wild and cultivated yeasts vary substantially in their sensitivity to sulfite and have several mechanisms for resisting its toxicity. The most efficient is a membrane protein (Ssu1p, encoded by the gene *SSU1*) that pumps sulfite out of the cell. Another protein (Fzf1p) seems to have the sole job of controlling production of Ssu1p. The level of activity of the *SSU1* gene varies considerably and one reason is because there are different versions of Fzf1p. However, some yeasts also have a second copy of the *SSU1* gene. This provides an opportunity for another sort of difference, namely in the DNA sequence around the gene that determines when, and how strongly, it is switched on or off. As a consequence, the copies in different locations often behave differently.

Researchers in Montpellier, France, in collaboration with colleagues in Padova, Italy, have been investigating some commercial yeast strains that are particularly resistant to sulfite. They already knew that there are a number of variations in the *SSU1* gene among the different strains of wine yeast. Nevertheless, these *SSU1* genes are in constant use by the cells. Their attention focused on a strain of yeast called 71B and they have discovered that, unlike other yeasts, it has three different versions of the *SSU1* gene. In addition, their level of expression increased during the fermentation process, and also if sulfite was present. To understand the basis of this very different genetic control, they examined the DNA around the three genes. Intriguingly, there were few differences.

The researchers therefore think that the explanation must lie in the signalling pathways that lead to the activation of the gene. This means that they may now have a way to identify how yeasts sense sulfites in their environment, something that is of considerable interest to winemakers. This work will allow the optimization of the industrial process of wine yeast production, preparing the wine yeast according to the sulfites found in grape musts, thus reducing the adaptation time (lag) phase which is of critical technological importance in winemaking.

Livestock Diseases and Zoonoses (*Phil Trans R Soc B: Biological Sciences*)

Editors F.M. Tomley & M.W. Shirley
Publisher The Royal Society (2009)
Details £59.50 | pp. 150 | ISBN 978-0-85403-770-4
Reviewer Tom Humphrey, University of Liverpool

This edition of the *Philosophical Transactions* Series contains 11 articles and an introductory chapter from the Editors. It is my perception from reading the articles that the remit given to the authors was to focus on infectious diseases of wild and domestic animals and to include some that are zoonotic. Thus major zoonotic pathogens like *Escherichia coli* O157: H7 and *Campylobacter* spp., which only quite rarely cause disease in food animals are not included.

In general, the book is an enjoyable and informative read, and is one that would be useful to veterinary and perhaps medical students. It will also provide useful background information to microbiologists and immunologists. There is also an excellent chapter on how livestock diseases impact on poverty and its alleviation. This would be a very useful read for sociologists.

The articles are written by leaders in their respective fields and this reviewer found most to be genuinely informative. Given that our climate is changing and there is an urgent need to improve global food security, the articles on 'exotic' diseases such as bluetongue, African swine fever and avian influenza were very informative.

There was very little in the book to disagree with, although in one chapter the statement was made that Norwalk virus (now called norovirus) infection was a minor disease burden to people. Given the many millions of cases that occur worldwide each year, this statement is difficult to agree with.

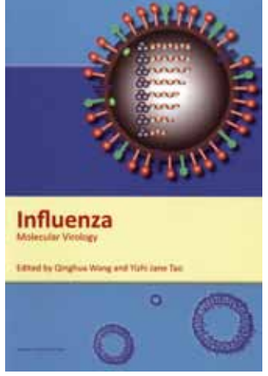
There is a good chapter on 'Molecular insights into farm animal and zoonotic *Salmonella* infections' but modesty forbids me from mentioning the authors!

This booklet would be a useful addition to personal and library collections and as background reading on a range of educational courses where animal and zoonotic diseases play a part.

Common Cold

Editors R. Eccles & O. Weber
Publisher Birkhäuser Verlag AG (2009)
Details £81.50 | pp. 354 | ISBN 978-3-76439-894-1
Reviewer David J. Evans, University of Warwick

This is an interesting and comprehensive monograph on the syndrome familiar to us all as 'the common cold'. Despite this familiarity, an unambiguous description of the common cold is not straightforward, especially where symptoms and causative agents are concerned and, irritatingly, many chapters contain their own redefinitions. However, the editors have generally avoided repetition and many of the chapters are data-rich, with good overviews of the epidemiology and treatments, many of which are refreshingly up-to-date. This reviewer found the chapters covering more general aspects of the syndrome – the history of the cold, 'over the counter' and herbal treatments, associated antibiotic usage – particularly informative and well-written. Important omissions are few, but include a description of the species C rhinoviruses in the catalogue of causative agents, unculturable though probably equally numerous as species A and B, and a more thorough overview of the murine model systems for studying the pathogenesis and treatment of rhinovirus infections. The book also contains a wealth of useful background information on the economic and societal impact of the common cold, and is recommended for institutional purchase.



Influenza: Molecular Virology

Editors Q. Wang & Y.J. Tao
Publisher Caister Academic Press (2010)
Details £159.00 | pp. 196 | ISBN 978-1-90445-557-8
Reviewer Paul Digard, University of Cambridge

Influenza has been something of a hot topic in recent years, in academic circles and the popular press, following the arrival of H5N1 'bird flu', and now the current pandemic of a swine-derived H1N1 virus. In one sense, this book is therefore timely, although the long production time for an edited book of this type means it misses out on discussing the 2009 pandemic.

The aim of the book, as stated in the Editors' preface, is to '*highlight some of the most exciting discoveries in recent years*' made by the influenza research community. The editors are both structural biologists, and this shows in the choices they have made over what constitutes such advances. Of the ten chapters in the book, seven revolve around crystallographic and/or NMR investigations of the viral proteins. The quality of each chapter varies, but is mostly high – I particularly enjoyed a very thorough account of the influenza A haemagglutinin. Only the final two chapters of the book (one on a specific approach to influenza diagnostics, one a mathematical approach to predicting vaccine design) seemed a little out of context, given the main focus of the book.

All in all though, it's a nicely put together book that summarizes recent developments on the structural side of influenza replication. Appropriate audiences for the book would be final-year virology students and influenza researchers. The price, however, puts it out of reach of the former, unless their departmental libraries purchase a copy.

Sex Hormones and Immunity to Infection

Editors S.L. Klein & C.W. Roberts
Publisher Springer-Verlag GmbH & Co. KG (2010)
Details £118.50 | pp. 319 | ISBN 978-3-64202-154-1
Reviewer Anthony Nash, University of Edinburgh

The importance of sex hormones in the control of infection is a neglected area in the pathogenesis of infectious disease. This book highlights the differences between males and females in their susceptibility to infection with viruses, bacteria and parasites. The key to this process is the way male and female sex steroids interact with cells of the immune response to either augment or inhibit protective host responses. The evolutionary significance of female dominance in controlling infection is contrasted with the hormonal upheaval during pregnancy and susceptibility to infection. This is a well-structured and eminently readable book. Those interested in the pathogenesis of infectious disease will find this a welcome addition. Recommended for institutional purchase as students will find this a useful reference source.

Cellular and Molecular Biology of Filamentous Fungi

Editors K.A. Borkovich & D.J. Ebbole
Publisher American Society for Microbiology (2010)
Details US$209.95 | pp. 802 | ISBN 978-1-55581-473-1
Reviewer Meriel Jones, University of Liverpool

This is a really good book. The perspective throughout focuses on filamentous fungi, but includes information on *Saccharomyces cerevisiae*, *Candida albicans* and the yeast cell form whenever it is of general interest and relevance. The 46 chapters are by well-known authorities from the filamentous fungal community and cover all the topics you could ever want. Each acts as a short up-to-date and advanced introduction, with many references to recent reviews and the primary literature for readers who want to go into topics more deeply. It is an excellent single reference source for anyone new to research with filamentous fungi or teaching advanced university courses, and takes full advantage of insights emerging from the genomics revolution. The inclusion of chapters on plant and animal pathogens at the end of the book brings out the importance of themes from earlier chapters and illustrate how filamentous fungal cellular and molecular biology have a major impact on human society. This complements the inclusion of applications in industry towards the start. The only drawback in this book is that all illustrations are in black-and-white, despite live-imaging using multicoloured fluorescent proteins and dyes now adding such beautiful insight into fungal cell biology.

Reviews on the web

Reviews of the following books are available on the website at **www.sgm.ac.uk/pubs/micro_today/reviews.cfm**

Retroviruses: Molecular Biology, Genomics and Pathogenesis
Editors R. Kurth & N. Bannert
Publisher Caister Academic Press (2010)
ISBN 978-1-90445-555-4

Infectious Disease and Host–Pathogen Evolution
Editor K.R. Dronamraju
Publisher Cambridge University Press (2010)
ISBN 978-0-52112-655-7

***Borrelia*: Molecular Biology, Host Interaction and Pathogenesis**
Editors D. Scott Samuels & J.D. Radolf
Publisher Caister Academic Press (2010)
ISBN 978-1-90445-558-5

Bergey's Manual of Systematic Bacteriology 2nd edn, vol. 3: The *Firmicutes*
Editors P. Vos, G. Garrity, D. Jones & others
Publisher Springer-Verlag GmbH & Co. KG (2009)
ISBN 978-0-38795-041-9

Metagenomics: Theory, Methods and Applications
Editor D. Marco
Publisher Caister Academic Press (2010)
ISBN 978-1-90445-554-7

Viral Oncology: Basic Science and Clinical Applications
Editors K. Khalili & K.T. Jeang
Publisher John Wiley & Sons Ltd (2010)
ISBN 978-0-47037-991-2

Functional Proteomics: Methods and Protocols
Editors J.D. Thompson, C. Schaeffer-Reiss & M. Ueffing
Publisher Humana Press (2008)
ISBN 978-1-58829-971-0

Molecular Biotechnology: Principles and Applications of Recombinant DNA
Authors B.R. Glick, J.J. Pasternak & C.L. Patten
Publisher American Society for Microbiology (2010)
ISBN 978-1-55581-498-4

To join our panel of book reviewers, email **y.taylor@sgm.ac.uk**

Bacterial culture samples. *Massimo Brega / Eurelios / SPL*

The decline in culture collections in the UK and Europe should worry all microbiologists. Their fundamental role and importance in microbiological research seems to have been forgotten and financial support has withered. How can the long-term future of these guardians of microbial diversity be guaranteed?

PAUL HOSKISSON

THE STATUS and long-term future of UK and European culture collections is of great concern. It is something that should worry all microbiologists, regardless of their discipline, as culture collections are central to the advancement of microbiology.

There is no doubting the quality and international relevance of zoological and botanical collections that are maintained within the UK. These large museums and herbaria are currently receiving financial investment and undergoing significant changes in terms of digitization and online cataloguing of resources, (e.g. the Millennium Seed Bank, the Synthesys project), although it is recognized that these funds are still insufficient. Culture collections are the microbiological equivalent of these, allowing re-examination of type materials and comparison of related strains, and they are repositories for microbiological diversity, enabling access to archived materials, etc., fulfilling all the roles of a museum or herbarium for microbiology. Generally, culture collections are run for profit, with additional Research Council or government funding; however, they are constantly under pressure for money to ensure their long-term future.

There needs to be radical changes in the system, use and expectations of these collections. Perhaps re-branding them as 'Biological Resources Centres' could facilitate and underpin the future of microbiology and biotechnology. Culture collections are essential for environmental (biodiversity), agricultural, health and commercial aspects of microbiology in their role as preservers and providers of microbiological material, as repositories for the protection of intellectual property and as resources for public and government information. The resources are currently in the form of strains and cell lines, but could be integrated with genetic data, especially as the cost of genome sequencing is falling daily. The future could involve the linking of sequencing centres and culture collections to provide an almost federalized system of biological repository. This has been partially achieved recently with the amalgamation of the National Collection of Type Cultures, the European Collection of Cell Cultures, the National Collection of Pathogenic Viruses and the National Collection of Pathogenic Fungi under the auspices of the Health Protection Agency Culture Collections (HPACC). This federated system is looking bright for the future health of these collections in the UK, following years of each one being under-resourced. However, HPACC does not encompass all the culture collections even within the UK, and there are still gaps within its remit (see **http://wdcm.nig.ac.jp/hpcc.html** for a list of world culture collections).

The loss of taxonomists through retirement and a subsequent reduction in teaching of systematics in universities has resulted in a decrease in the quality of taxonomic manuscripts submitted to journals and strains submitted to culture collections. Perhaps the offering of specialist training courses by culture collections in taxonomic methods and procedures, maintenance and preservation of strains would improve the situation. DSMZ offer identification services; maybe UK collections could go a step further by offering training? This would increase the level of expertise, the validity of new species descriptions and the quality of manuscripts submitted to journals which publish taxonomic papers. This would, ultimately, also generate a revenue stream for the collections.

In the far east, Japan, South Korea and China have invested heavily in taxonomy and systematics in the last 15–20 years, providing funding for students, investment in biological resource and drug discovery centres, linking culture collections and genomics with drug discovery, medicines and therapeutics – all commercially targeted, yet all underpinned by the culture collection and taxonomy.

We all rely on using the correct strain for our experiments, and with recent high-profile cases of cell lines and strains being mixed up and the wrong ones being used in crucial experiments, the provision of authenticated strains for researchers is essential. Maybe it is time for a radical rethink of how culture collections are used; but if we do not use them, then we will lose them!

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